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GUGLIELMO MARCONI, WHO HAS SENT WIRELESS MESSAGES ACROSS THE SEA, THE MOST REMARKABLE ACHIEVEMENT OF THE NEW CENTURY.

MARCONI'S PLANS.

MR. MARCONI was the guest of honor at the annual dinner of the American Institute of Electrical Engineers at the Waldorf-Astoria, New York, on January 13. Even the decorations were arranged in compliment to the inventor. At one end of the room the name of St. John's blazed in electric lights; at the opposite end the name Poldhu, and between these the electric current played like a lambent flame along cables, upon which at intervals were three dots, or more particularly, three very small incandescent lights in a group, the experimental letter "S" which Marconi flashed from Cornwall to Newfoundland.

Mr. Marconi, in a very interesting speech which held the closest attention of everyone in the room, not only described something of what he had done and what his aims were, but let it be known that according to his first intention these transatlantic experiments were to have been made between England and the United States, instead of England and Newfoundland.

Mr. Marconi, in his address, expressed his thanks and gratitude for the great reception and said that he was highly honored to be entertained by such an important body, as it was well known all over the world that America stands first in electrical engineering. He felt deeply the compliment of being honored by men whose names were household words all over the world.

Turning to what had been accomplished under his invention, he said that more than seventy ships now carry permanent installations for operating with wireless telegraphy. Of these thirty-seven are in the British navy, twelve in the Italian navy, and the others are on Atlantic liners. There are more than twenty stations, he said, in Great Britain and on the continent of Europe, with other stations here or soon to be here.

"I think I am right," he said, "in saying that there is a general belief that when a message is once intrusted to space by this system, any one with a receiver may pick it up. This objection to the earlier form of operations has recently been largely overcome. It has been found possible so to attune one transmitter to one receiver as to make it practically impossible for any one not acquainted with the qualities of those particular instruments to read the message.

"This is not the case with the installation on ships, because when a ship wishes to communicate with another in emergency she wants to be able to call up any other ship within range. For this reason, the installations on all ships are uniform, but on land or between lands we now use attuned installations. It was found possible by attuned instruments to cross 200 miles of land and that the power required for this was only such as is wanted to run a small incandescent lamp.

"It was then determined to erect two comparatively powerful installations, at Cornwall and at Cape Cod, for the conduct of experiments across the Atlantic. Unfortunately a hurricane partly destroyed the installation at Cape Cod and necessitated a postponement for some months. Rather than let the interval go by, it was thought well by a temporary installation at St. John's to try to cross 2,000 miles of ocean rather than 3,000 miles; so the attempt at Newfoundland was made with kites and balloons.

"Work with these meant a great deal of trouble, owing largely to tempestuous weather, but for a short time the kites were got into a correct position, and we got a succession of signals at the right time and at a prearranged speed. This was doing pretty well for an installation dependent on wind and weather.

"We should have done more there, except for finding out that the Anglo-American Cable Company had a monopoly of all forms of telegraphy there, and seemed to claim in a certain way a monopoly of the air and the sea. In England the British government has a monopoly of the telegraph, but I am glad to say that the government rather encouraged my work than attempted to interfere with it.

"The government did not seem to think of interfering with experiments made in the interest of science, but in Newfoundland the cable company did, although the manager of the company there told me that they got 50,000 words through in three days, owing to my presence.

"It was thought better not to put up a permanent installation in such a place, and so it was decided to cross to Nova Scotia, ninety miles away, and I think that a permanent station will be established there and that the one at Cape Cod will be repaired.

"I do not wish to be too confident, but I think that it will be possible in a short time to transmit a message, or perhaps several messages at the same time across the ocean in a commercially practicable manner. I think that it will be possible to bring about communication between people far apart at greatly reduced rates. Those at present are beyond the reach of people of ordinary means, but should my dream be realized, the cost of cables may be very substantially reduced, and another link will be forged in the ties that bind this country to Great Britain.

"I desire to say in this presence that I have built very greatly on the work of my predecessors, and I wish to mention Maxwell, Lord Kelvin, Prof. Henry, Prof. Hertz, Prof. A. G. Bell. Had it not been for the invention of the telephone I do not know whether at this date we should have received messages through the air across the Atlantic. They might have come later with greater power, but by the aid of the telephone they have come now."

For our engraving we are indebted to the Illustrazione Italiana.

CONTEMPORARY ELECTRICAL SCIENCE.*

MAGNETIZATION BY LIGHTNING.—Some further results of the exposure of basalt rods to induction by lightning are communicated by F. Pockels. The rods were mounted near the lightning conductor of the Monte Cimone Observatory. One rod was mounted in its place in September, 1900, and could not be removed until June 3 of this year, owing to the configuration of the snow. The magnetization indicated a maximum current intensity of 5,600 amperes in the lightning flash. But as the date of the flash is unknown, and much of the magnetization may have been lost, this figure only represents a lower limit, two further rods, recently influenced by lightning discharges of known date, showing magnetizations indicating a current strength of 5,000 and 3,600 amperes respectively. Since they were attached to the two branches of the earthing conductor respectively, it may be assumed that the total current strength of the flash was 8,600 amperes, or a little more. Some other rods exposed to a flash on August 13 showed no trace of magnetization, and the author supposes that there are oscillatory lighting discharges, and that this was one of them. It would be well if personal observations of the flashes could be simultaneously recorded.—F. Pockels, Physikal. Zeitschr., October 15, 1901.

IONIC VELOCITIES IN GASES.—The ratio of the velocities of negative and positive ions in point discharges through gases has been put at values ranging from 1.32 (Zeleny) to 1.58 (Townsend), the negative ions being invariably the more mobile ones. K. von Wesendonck inquires whether this peculiarity can be brought into harmony with the conductivities of the various gases for point discharges. It is well known that oxygen does not encourage negative discharges more than positive ones. Sieveking found, in fact, that a positively charged point discharges more easily in oxygen than a negatively charged point. In nitrogen, on the other hand, the negative current is several times, and according to Warburg, several hundred times stronger than the positive current. As the ionic velocity is always greater for negative than for positive ions, it follows that these velocities cannot be the determining element in facilitating the discharge. The author suggests other determining elements, such as dust, disintegration, occlusion, and chemical attack.—K. von Wesendonck, Physikal. Zeitschr., November 1, 1901.

RECTIFIERS FOR X-RAY WORK.—The difficulties in the way of working X-ray tubes with alternate currents are serious, as the tubes flicker unless the current traverses the induction coil in only one direction. E. Knoblauch found that even Ruhmer's new interrupter could not be used with an alternate current of 50 periods and 110 volts, probably on account of the voltage being too low. But since it is specially desirable to be able to use low commercial voltages, he used the expedient of introducing an aluminium rectifier in the circuit, consisting of a lead and an aluminium electrode immersed in a 20 per cent Seignette solution. It is thus possible to use Wehnelt, Simon, and even mercury-jet interrupters. All of them worked faultlessly after introducing the rectifying cell, and the Roentgen tube showed a sharp division of the two halves, thus proving that only one phase of the alternate current is transmitted to the interrupter. The electrolytic interrupters all require somewhat strong currents, and thus lead to greater wear of the Roentgen tubes. Mercury-jet interrupters do not require great current strengths, and the use of the rectifying cell as described is, therefore, specially recommended in their case.—E. Knoblauch, Physikal. Zeitschr., November 1, 1901.

* Compiled by E. E. Fournier d'Albe in The Electrician

THE "LATENT HEAT" FALLACY.

By R. H. THURSTON, Professor of Engineering, Cornell University.

THE accounts of the new ether vapor engine recently appearing in the Paris technical journals and one of which was reproduced in the SCIENTIFIC AMERICAN, January 4, 1902, revamp an old, and apparently still vigorous superstition among inventors. It is of such general acceptance and of such importance in its tendency to lead both inventors and investors astray and to waste time, talent and money, that it should be shown to be a fallacy so effectively that, among readers of the SCIENTIFIC AMERICAN at least, there can be no longer the slightest doubt.

In the article above referred to, it is said that the inventor of the new ether engine was induced to seek its perfection, being as stated, "struck by the theoretical advantages of ether over steam." The anticipated gain in the ether engine is assigned to the fact that whereas, in the case of the steam engine, in the exhaust "it has lost without utility the 971 British thermal units furnished to every pound of water in order to cause it to pass from a liquid to a vaporous state," this loss "may be notably diminished by using, instead of water, a volatile liquid that does not possess such great latent heat of vaporization."

So far from the truth are these statements that it would be more correct to reverse them. Rather than being a source of waste and loss of efficiency, so-called "latent" heat, and nothing but "latent" heat supplies the power of heat engines working in the most perfect cycle, attaining the highest possible efficiency and performing the largest possible quantity of work per unit of working fluid and of heat supplied from the fuel.

In the ideal gas engine of Carnot, the "perfect engine cycle" being employed, this transformation of energy affects the "latent heat expansion" of the gas and "latent" heat only; in the steam, ether, or other vapor engine, this heat, in the perfect engine cycle, with maximum possible efficiency, is the "latent heat of vaporization," and "latent" heat only. In neither case is sensible heat transformed at all; only "latent" heat is utilized.

In the gas engine of Carnot, every unit of heat entering the fluid in the progress of expansion is instantly converted into mechanical energy and work. The flow of heat into the charge occurs continuously at a constant temperature and the flow of energy out of the charge is just as continuous; and in the inflow of thermal energy and the outflow of its equivalent transformed mechanical energy, the one precisely balances the other, the air or gas neither gaining nor losing sensible heat in the process. The thermal line on the indicator diagram exhibiting this process is "isothermal." The Carnot cycle consists of a pair of isothermal lines, top and bottom, crossed by a pair of "adiabatics" along which no heat is either received from the furnace nor given up to the refrigerator and along which the heat stored by conversion into work during expansion is restored during the later compression. All the heat received by the charge is received at the higher temperature and wholly converted into work, and all the heat rejected is rejected at the lower isothermal in the process of holding down the temperature of the working substance to a constant minimum.

The principle of Carnot is thus complied with and all heat passing from the source to the working fluid is received by the latter at the highest possible temperature, at a constant temperature, and all heat rejected into the refrigerator, condenser or other receptacle for that heat, is rejected at a constant and minimum temperature. This may be paraphrased and we may say that, in the heat engine of maximum possible efficiency, the range of temperature employed is made, and is retained, a maximum entirely across the cycle. The difference between heat received and heat rejected is necessarily a measure of the thermodynamic conversion of energies.

The steam or ether vapor engine, working in the most perfect cycle, also complies with the Carnot principle. Its indicator diagram consists of a pair of constant-temperature lines, "isothermals" (which, in the vapor engine cycle are also lines of constant pressure), crossed by a pair of "adiabatics." The maximum temperature is that of vaporization, and all heat entering the charge enters as "latent heat of vaporization." All heat leaving the working fluid leaves it at the temperature of condensation, at the lower limit of pressure, both of which remain constant during the process, and the line is both isothermal and of constant pressure. This rejected heat is that which, with reversal of this action, at that lower temperature and pressure level, would be the latent heat of vaporization at that lower limit. The pair of adiabatic expansion and compression lines do not either give the charge heat, from the source, or reject heat into the refrigerator or condenser; they temporarily transform heat into work in expansion, restoring it during compression, and all change of temperature in either direction is due to this action.

Thus all heat supplied for transformation into work is supplied as "latent" heat and the approximation of heat engines to perfection is the more complete as they evade the transformation of sensible heat and secure their mechanical energy by utilization of "latent" heat. The defect of the ordinary heat engine is evidently not that it employs a fluid having a large measure of so-called "latent heat," but rather that it does not employ "latent" heat and nothing but "latent" heat.

Carnot showed, as long ago as 1824, that, as he stated it, "the maximum of motive power resulting from the employment of steam is also the maximum of motive power realizable by any means whatever."

He further asserted, at that time: "The motive power of heat is independent of the agents employed to realize it; the quantity is fixed solely by the temperatures of the bodies between which is effected, finally, the transfer of the caloric."*

It has thus been perfectly well known for many years that the inventions by which it has been sought to evade the utilization of latent heat in the vapor engines, by substitution of other fluids, have been based upon a fallacy. In fact, the reasons given by these inventors for the use of other vapors logically compel the adoption of a gas for the heat engine, not ether, chloroform or ammonia, and the air engine should be substituted for all steam engines—if they are correct.

But while this is true and while, thermodynamically, there is no intrinsic advantage in the use of one fluid rather than another between two specified temperatures, and while the latent heat theory here criticized is a pure fallacy and quite the opposite of the truth, it does not at all follow that, practically, all substances are equally available for heat engines. There are other conditions and many controlling circumstances which determine choice. The subject has often been studied by engineers and men of science and, although it has commonly been concluded that, of all the available fluids, none is on the whole superior to water for this purpose, it does not necessarily follow that there may not be cases in which some other substance is more desirable or even that some other substance may not practically permit a larger transformation of heat into work. In the operation of heat engines, the temperature and pressure limits are always more or less fixed by external conditions and we cannot attain higher temperatures in the steam engines than those of steam of the highest safely controllable pressure, or higher pressures in the gas engine than those accompanying the highest safety controllable temperature; nor can we adopt a lower temperature for our minimum than that of the external world. That working substance which most perfectly adapts itself to these limits and, within them, provides the best adjustment of temperatures and pressures and highest net return of work for heat, it economically best—always provided its use is consistent with highest financial returns and contributes to the production of good dividends by affording a decided profit over all costs.

Thus the fallacy of the idea of the inventors of the ether vapor and similar engines becomes evident. So-called "latent" heat is the desirable form of energy in heat engines. In fact, probably, this confusion in the minds of the uninformed respecting "latent" heat arises from its unfortunate cognomen. "Latent" heat is, in fact, heat transformed into work and the work on the steam engine piston, for example, during the forward stroke of the piston up to the cut-off, is not performed by the steam in the engine, but by the steam at the instant forming in the steam boiler, which pushes out of its way the superincumbent steam and, through that displacement, pushes the piston, thus doing the work shown on the indicator diagram up to cut-off.

That this "latent" portion of the heat supplied is most efficiently utilized, rather than, as claimed, completely wasted, is easily seen by anyone who will take the trouble to compute—as did Mr. G. H. Babcock many years ago†—the weight of steam per horse power hour

* Carnot, Thurston's trans., pp. 55, 68; N. Y., J. Wiley & Sons.

† Manual of the Steam-Engine, Vol. I., Sec. 112.

required by even the ideal engine, under common conditions of temperature and pressure, assuming all "latent" heat wasted and only the sensible heat taken up by the feed-water being thermodynamically utilized. It will be found that, in the example taken, nearly 90 pounds would be demanded, where the "perfect-engine cycle" would do the work on less than 10 pounds. Again, a steam engine receiving 20 pounds of steam per hour would only thus receive about 200 B. T. U per pound, 155,600 foot pounds of energy, or less than one-tenth horse power per pound, 2 horse power from 20 pounds, of which it might utilize one-eighth. In other words, "latent" heat performs the principal part of the work in the steam engine.

The volatile fluids, like ether, ammonia, chloroform, carbon disulphide, sulphur dioxide, etc., may prove to have their uses in heat engines, but for quite other reasons. They may permit the utilization of low-temperature heat in paying quantity. This, at the moment, is a question which is particularly interesting the engineer in view of the claims based upon the Berlin experiments of Prof. Josse.

To utilize low-temperature heat, if we are to find that profitable at all, we must employ other fluids than steam, simply because, at those low temperatures at which we exhaust steam from the cylinder, ordinarily, the pressures are too low to drive our machinery and because the size of engine required to handle the steam for any stated power becomes enormously and impractically large. A working fluid giving the general action of steam, but with comparatively high pressures at and below the temperatures of exhaust of the steam engine, if unobjectionable on the score of cost, direct and incidental, or of danger or serious inconvenience, might add a large fraction to the power derivable from the uit of heat or of fuel employed. This last is the line of improvement which has been sought so often during the past two generations by inventors of the "binary-vapor engine." It is here, if anywhere, that the volatile liquids may find their place in the heat engines.

This field of invention is open to all. The idea is very old and such patents as are fundamental have probably all long ago expired, leaving the would-be inventor entirely free to seek a way of utilizing low-temperature heat in volatile fluids and high-temperature heat equally far removed, apparently, from the range of the ordinary steam engine by the employment of other fluids appropriate to that higher portion of the scale of temperature.

THE NEW UNITED STATES WARSHIPS.*

No warships, perhaps, have had so many vicissitudes as the United States battleships of the "New Jersey" class. Once again they have been definitely decided on, permanently, perhaps, now; but it need not be forgotten that earlier designs have been "final" also. There is no getting away, however, from the fact that each new finality has been better than preceding designs. As with each the displacement has gone up this is not to be wondered at; but the great and essential point is this increase of displacement. In the past American ideals have tended to "whip creation" with the minimum of displacement; now obviously nautical influences can be seen at work, with the result that we observe an honest striving after a real best in place of what—rightly or wrongly—has hitherto been under suspicion of being rather a paper best. In fine, America is now definitely settling to building American warships to American needs.

The new battleships are to be of 17,604 tons normal displacement, 450 feet long by 76¾ feet beam by 26¾ feet maximum normal draught—the relatively small draught being necessitated by the depth of water about the American coast. Our 16,500-ton "King Edward" class will be, therefore, small ships beside them. The main belt, 9¼ feet deep, will be 11 inches thick on the water-line amidships, this thickness soon fading to 9 inches, and diminishing to 4 inches at the extremities. Here, then, we have the maximum of moderation in the disposal of the 4000 to 4500 tons odd of armor. No weights have yet been published, but, very approximately, this belt can be put at about 1500 to 2000 tons odd. A 7-inch belt protects the lower deck above—roughly, another thousand tons nearly. This, of course, includes bulkheads. The balance of the armor goes to barbettes, turrets, and battery. The armament will be four 12-inch guns in the usual turrets, eight 8-inch at the angles of the superstructure—the somewhat amateurish superposed turret idea being discarded; and ten or twelve 7-inch guns in the battery, protected by 7-inch armor. This 7-inch gun is a piece yet to be built. It is to be adopted because it "will pierce 7 inches of armor at 3000 yards." At sea, in battle, it is not likely to do anything of the sort, and the carrying of armor-piercing projectiles for the purpose must lessen the supply of the more useful common and high-explosive shell. However, no constructors have yet grasped the idea that secondary guns are shell guns, and that with high explosives to burst outside near a gun muzzle is likely to be more destructive than to make a hole in the place where the gun is. The great thing is to disable the gun. The burst of a 7-inch shell will be far superior to that of a 6-inch, but the latter is, with high-explosives, powerful enough for anything against so ideal a target as a ship. The Americans would, we think, have been wiser to have had the same weight in 6-inch pieces, unless—as is possible—space for them and their ammunition arrangements constitute the objection.

A remarkable feature of the new ships is the absence of all torpedo armament. This, too, we consider a mistake. After all, the weight of submerged tubes is a bagatelle in 17,604 tons; nor ,in so large a ship can the saving of space matter very much. Useless the torpedo may be for long-range actions, but it has had much to do with the new leaning to long range work. After many guns are disabled, after speed is reduced, ships are likely to get within torpedo range, while the absence of tubes is a draw to the enemy to do so. To be sure, by then all directors may be smashed; but of this there is no certainty, while the same objection might be extended to sighting hoods for guns and many other things.

We have drawn attention to these defects, not in a carping spirit, but because in spite of them we still hold these 17,604-ton ships, so far as the meager details available allow, superior to any other battleship designs, not merely as ships, but per ton of displacement. Political events, too, add an interest to American sea power. We are small believers in the Utopian dreams of a great Anglo-Saxon world-empire; but there are many indications that, whether the idea be pleasant to Americans or not, the great war of the future will find their ships fighting side by side with ours.

The new cruisers are, as yet, so shadowy that it is impossible to criticise them to any extent. But nothing could be sounder that the principle laid down by the Board, that while a battleship may have 22 to 28 per cent of armor, cruisers must be content with from 7 to 20 per cent—the balance being expended in speed. It is a palpable truth enough; but a review of existing types would hardly go to prove it conclusively. The nations are realizing it slowly.

The armament spoken of for these vessels is four 10-inch and sixteen 6-inch—no great change over existing models, save in the adoption of 10-inch in the place of 8-inch for the turret guns. The horse-power is 25,000, with 22 knots. For the battleships, speed has been written down as a minor desideratum, and they will be 18 knots only, with 16,500 horse power.

A very important feature in both types is the abolition of triple screws, after which the engineer-in-chief is supposed to hanker. Executive officers seem to have formed the opposition, and they have carried the day on the grounds that however advantageous the triple system may be in coal economy, it lacks the tactical advantage of the twin-screw system. Purely engineering disadvantages might also be alleged, but the primary question is one of fighting capacity. With two screws there is over 8000 indicated horse power available for assistance in a sudden turn; with triple screws considerably less power is available. This is the gist of the argument that has carried the day again with the United States Construction Board, and it argues a sound appreciation of a warship as a fighting machine before all else. This is the dominant note all through the report, from the specific reasons against wood sheathing—of which we shall have more to say on another occasion—the situation of magazines and facility of ammunition supply. Never before do we remember to have seen American designs thought out with so single an eye to the practical in all things. One may well contrast these new battleships with the "Iowa," of 6000 tons less displacement. The "Iowa" has almost as much weight of armor, while in armament the chief difference is ten 7-inch instead of six 4-inch—a small matter of weight in 6000 tons. The new type ship will carry 2000 tons of coal normally, an increase of 1375 tons over the "Iowa," and her horse power, and consequently the weight of machinery, is increased. Still the 6000 tons is not to be made up with these things also, and there is indubitably a heavy balance expended in strength, in solid necessaries, that do not show on paper.—The Engineer.

* The warships herewith referred to by our contemporary are not the "New Jersey" class, but their successors, whose designs have recently been decided upon by the Board on Construction. There will be two of these ships and their names have not yet been decided upon. The displacement given, 17,604 tons, is too large. On a mean draft of 24 feet 6 inches they will displace 15,560 tons, and on a maximum draft 16,900 tons.

THE CULTIVATION OF TOBACCO IN CONNECTICUT.

By CARLOS DE ZAFRA.

TOBACCO in Connecticut is raised principally in the Connecticut and Housatonic valleys, although it is also raised in various parts of the State. In view of the fact that in the sections where it is raised it is the sole product upon which the farmers depend for their support throughout the year, we believe that a description of the methods there employed in its cultivation would be of interest.

In the early spring, as soon as the frost is out of the ground, the seed, which is extremely small and black, is sown in nicely mellowed beds of rich ground, located on the south side of a fence or hill, or in some place not exposed to the cold winds. The seed is sprouted in rotten wood or between sods indoors until the cleet just begins to show, when it is mixed with wheat or rye bran and sown sparingly over the prepared beds. It has been found advisable to keep the beds covered with glass or cloth until the plants appear and while they are small, although they may be left to the open air during the middle of the warmer days. Ammonia in varnish water, if used sparingly, is found to expedite their growth. The beds are kept as clear of weeds as possible. If the seed is sown about April 1, the plants will be found sufficiently large to transplant about June 1.

In order to raise a fine quality of tobacco the ground should be of the light loamy character, well fertilized with specially prepared tobacco fertilizer, or part barnyard manure. The ground should be twice plowed and thoroughly harrowed that the earth and the fertilizer may be thoroughly mixed, thereby insuring a quick and even start for the plants as soon as transplanted in the field.

When the ground has been thoroughly prepared it is marked out into rows three feet apart, and by means of a pointed stick holes a foot and a half apart are made the full length of the rows. These are the distances generally observed by the growers in the Housatonic Valley. By means of a watering can each hole is filled with water before the plant is inserted. Only one plant is placed in each hole and the ground then pressed around the roots.

To insure a good crop tobacco should be cultivated as many as three times, in order to keep the ground mellow and free from weeds. When the plant has grown sufficiently to possess 16 to 18 leaves, everything above that should be destroyed by breaking off, which process is called "topping," and has to be done two or three times during the growth of the plant. The stalk should also be kept clear of branches or "suckers," the object being to confine all the nourishment obtained from the ground to the leaves. Great care has to be exercised to keep worms and insects from eating the leaf; for the more perfect the leaf the more valuable the crop. After topping has commenced not more than four or five weeks should elapse before cutting. The proper degree of ripeness can be told by the thickness and brittle condition of the leaf.

The cutting, handling and hanging of the tobacco require great care in order that the leaf shall not be torn or broken. The plant, which has a woody stalk about an inch or so in diameter, is cut close to the ground by means of a hatchet or saw, and is laid carefully upon the ground to wilt, which it does rapidly, hence care must again be exercised that it does not remain on the ground too long lest it should be burned by the sun. After it has wilted sufficiently it is strung on lath, five or six plants to each lath. This is accomplished by the employment of a hollow steel needle which can be adjusted to the end of the lath, and is passed through the center of the stalk near the base. In order to cart the tobacco from the field to the barn, a high rigging is built and placed upon the framework of the farm wagon.

In the barn there are a series of poles placed horizontally, from which the tobacco is hung. In a well-built barn these poles are placed four feet apart, from center to center, and five feet vertical distance from one tier to the other. The ends of the lath containing the tobacco rest upon these poles and are placed nine inches apart in order to insure uniform ventilation and curing. Tobacco sheds are so constructed that they may be easily opened for ventilation.

After hanging, about nine weeks elapse before the plants are sufficiently cured and ready for "stripping," which consists of separating the leaves from the stalk. Owing to the exceedingly brittle character of the leaf this can be done only on the warmer damp days, which have the effect of softening the leaf, making it silky and pliable. Boxes 8 x 16 inches and 3 feet in length, and lined with hardware paper, are used for this purpose. Into the boxes the leaves are placed, the bases toward the end of the box, so that the tips will overlap in the center. When removed from the box they are removed with the paper and tied into bundles. Tobacco which has been stripped at the proper degree of dampness and properly packed will remain in the same condition for several months. In this manner it is taken by the farmer to the warehouse, where it is sorted leaf by leaf, according to its shade and quality.

The average price for tobacco in the Housatonic Valley for the past four years has been from 15 to 16 cents per pound. In the Connecticut Valley somewhat better prices have been realized. It is the best cash-producing crop that can be raised by the farmers in Connecticut, as it will bring from $250 to $400 per acre. The most valuable part of the crop is in the light-colored wrappers and binders for good seed and imported Havana filled cigars, and the packers generally find an open market for it.

In the cultivation of the weed one great risk is always taken, however, and that is the possibility of an entire crop being totally destroyed by hailstorms, which occasionally sweep over the tobacco sections. The hail tears the leaf to pieces, rendering it either entirely useless or reducing its value from a possible 16 cents to 3 or 4 cents a pound. In fact, during the past summer, in a few instances, the crops were so completely destroyed that what remained was plowed under. This, however, was an exceptional case, but it serves to illustrate the risk which prevails.

METAL WORKERS' SCHOOL IN SAXONY.

AN exhibition of the work done by pupils of the Metal Workers' School at Rosswein has recently been held at Freiburg, which showed the thoroughness of the instruction given. The school has an average of sixty to seventy students, and the pupils are chiefly from Prussia and Saxony, but all sections of Germany are represented, and even Austria and Sweden. One of the conditions of admission is that the pupil shall have had three years' practical experience. Many of the States of Germany are liberally aiding the school, and granting free scholarships to deserving young men. The school is provided with a technical library, reading and reference room, and has a large supply of scientific apparatus, electro-motors, batteries, etc., and many practical models of buildings, machines, etc. Excursions are frequently made by the pupils to the large factories and mines of importance in the neighborhood. The course at the school lasts from eighteen months to two years, and embraces four departments—building, fine arts, machines and electro-technics. A great deal of attention is given to drawing. The student is taught to create, and in order to stimulate the inventive faculties the German Patent Office supplies the institution free of charge with copies of patents pertaining to mechanical, metal and electrical apparatus. In addition to the special branches in metal work, etc., attention is also given to physics, chemistry, algebra, geometry, bookkeeping and German language lessons. The tuition fee for the half year is 100 marks (£5) for citizens of the German Empire, and 200 marks (£10) for foreigners, and an additional fee of 25 marks (£1 5s.) for German, and 50 marks (£2 10s.) for foreigners for the use of apparatus, machines and material. The city of Rosswein has about 8,000 inhabitants, and is situated on the main railway line between Leipzig and Dresden.

Means of Distinguishing Egg Albumen from Blood Albumen.—According to Guerin, blood albumen upon addition of formol in the proportion of 15 to 20 per cent does not give any precipitate, but loses its precipitability after some time through heat as well as through nitric acid.

Egg albumen solution remains clear with formaldehyde and is no longer thrown down by heat, but always retains the property of being separated by nitric acid in the cold; hence, formol must have a different action upon the two kinds of albumen.

Serum albumens are rendered perfectly insoluble by formol. Strong solutions yield a gelatinous coagulum, while dilute solutions give a flocculent or pulverulent deposit.—Chemiker Zeitung.

NEW SATRE DREDGERS FOR SERVICE ON THE LOWER SEINE.

THE lower reach of the Seine, from Rouen to the open sea, had, until recently, been practically unused for maritime service, although it might have been made a first-class channel for commercial purposes. Navigation, as far as Rouen, was carried out under very great difficulties, owing to the varying nature of the water discharge and the changing depths. Up till 1848, of the 78 miles which separate Rouen from the sea, 37, at least, formed an estuary of exceedingly great width, useless in the point of view of navigation, the fairway being a shallow and very changeable one, in the midst of shifting sandbanks and mud. In the period from 1848 to 1866 a series of longitudinal dykes were built on both banks, the total developed length of which rapidly extended to over 40 miles; these gave good results in the sense that they deepened the channel at many places. From 1866 to 1885 no new work was carried out, and the maintenance in good state of repair of the dykes previously built—with unsuitable material—was very laborious. Since 1885 attempts have been made to improve the conditions of navigation up stream from the Risle River, and the conditions of the estuary proper. The object is to regulate the distance between the opposite banks in such a way that the body of water available is the largest possible, dredging being resorted to in order to improve the flow and deepen the channel. In 1895 a powerful bucket dredger was put in service; this was found very efficient, in that it easily reduced to 3 feet under the zero of the charts, beds that were formerly above zero. As soon, however, as an experienced suction dredger had been tried and found to give excellent results, the Seine Board of Works ordered three powerful ones of this system from the Societé des Anciens Etablissements Satre, of Lyons, Arles, and Rouen.

There being very rough weather on the Lower Seine, and as there could be no question of putting the dredgers in shelter when not in actual work, they had to be built seaworthy throughout. They, in fact, traveled under their own steam from Marseilles to Havre, having been built at Arles, in the South of France, and behaved perfectly well in the crossing. The details and principal dimensions of the dredgers in question are given in Figs. 1 to 6. The hull is divided into compartments by eight watertight bulkheads. The first compartment is the forepeak, used as a hold; the second one is the crew space, with berths for eight men. The next compartment contains the officers' cabins and one cabin for the Ponts et Chaussées engineer, who has charge of inspecting and supervising the work done. In the following compartments are the sand and mud wells, the normal capacity of which is 17,658 cubic feet, the maximum capacity being 20,483 cubic feet, when extension tops are put round the openings of the hoppers, which is possible in fine weather. The wells are seven in number, fitted with two pairs of doors or sluices. The next compartment forms the engine-room, and also contains the dredger pumps; the one next to it is the stokehold, with coal bunkers, the last one being the chain locker.

There are in each dredger two vertical compound engines, capable of developing together a total of 540 indicated horse power at 150 revolutions. This type of engine has been built in large numbers by Messrs. Satre for various purposes. Their principal dimensions are the following:

Diameter of high-pressure cylinder	0.440 m. (17 5-16 in.)
Diameter of low-pressure cylinder	0.800 m. (31½ in.)
Stroke	0.450 m. (17 11-16 in.)

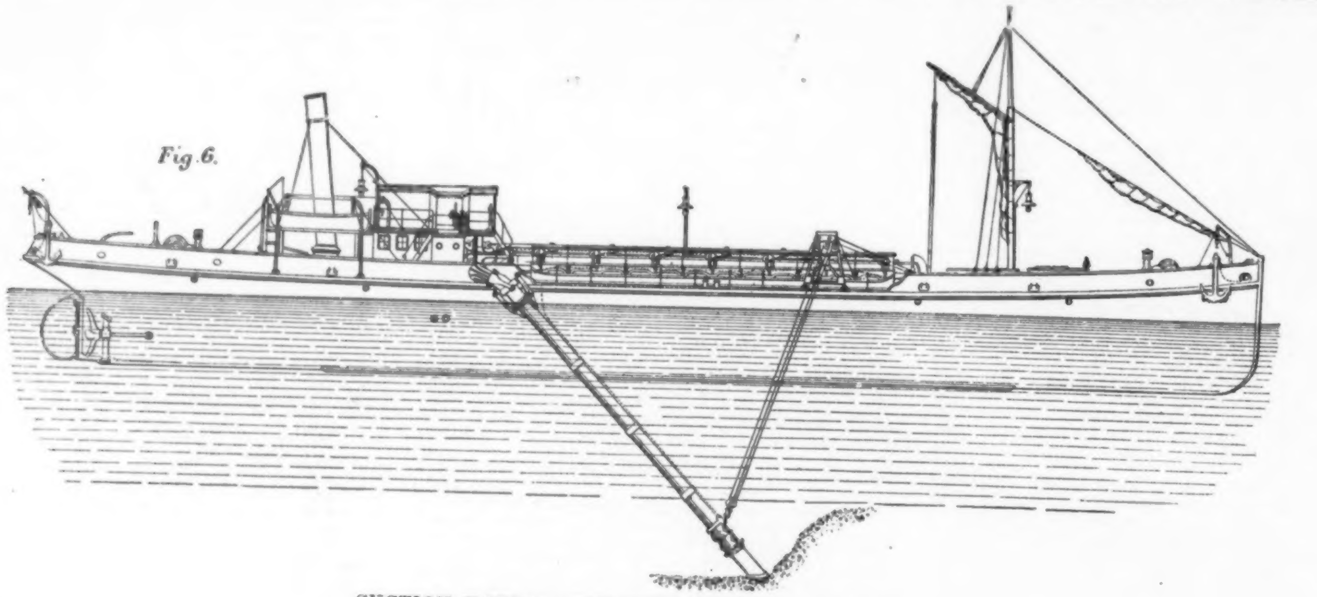
They are surface-condensing; the condenser is placed horizontal, and forms part of the engine frame. The valves are easily accessible for inspection and maintenance in good working order. The engines are so arranged that they can readily be made to drive, together or separately, both the propellers or the pumps. The boilers are Belleville boilers, fitted with economizers of 2,154 square feet heating surface, with two donkey pumps, and with an air compressor of 8,830 cubic feet. A fresh water tank can supply the boilers during a continuous run of 75 hours; suitable apparatus are provided for filtering the feed-water taken from the drain-pipes by condensers.

Each dredger is driven by two propellers worked from the engine shafts through couplings. The propellers are independent one of the other, and can turn inversely, this being rather a novel feature for this kind of craft.

The dredging device consists of two centrifugal pumps worked from the main engine. The pump shells are cast in one piece, and provided with manholes for removing all obstructions when necessary. The suction turbines have four blades, and contain a special arrangement which prevents the sand from penetrating between the blades and the inside walls of the pump body. The door-pieces on the front part of the pumps carry the suction necks which are connected through an elbow that runs through the deck and a horizontal conduit, to another neck; the latter is fitted to the suction pipes through another elbow, a flexible length of tubing and a Hooke's joint. The suction pipe can draw sand from a depth of 43 feet below water level, and can work even during a rolling swell of 19 inches. The joint with the suction pipe being level with the deck, all work of maintenance and repair is easily carried out. The discharge from the pumps is effected through shoots, each with seven openings, provided with sluice doors to regulate the delivery on the dredger. Hoppers of perforated plates are provided in the sand wells.

Double steam winches are placed on deck at both

Fig. 6.



SUCTION HOPPER DREDGER, SEINE NAVIGATION.

Fig. 1. Fig. 2. Fig. 3.

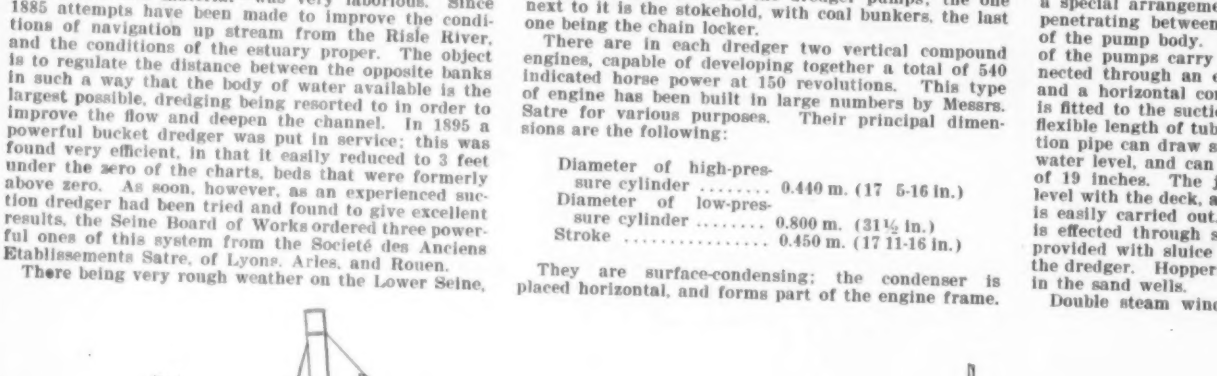
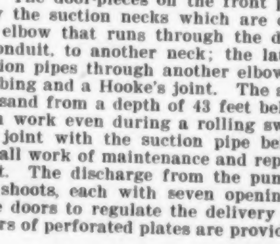


Fig. 4. Fig. 5.



LENGTH OVER ALL	197 FT. 2 IN. (60.120 M.)
LENGTH BETWEEN PERPENDICULARS	187 FT. 2 IN. (57.120 M.)
BREADTH	34 FT. 5 IN. (10.500 M.)
DEPTH OF HOLD TO TOP OF KEEL	14 FT. 5 IN. (4.400 M.)
DRAUGHT LOADED	11 FT. 6 IN. (3.500 M.)
DEPTH OF SUCTION	42 FT. 7 IN. (13 M.)

SUCTION-CARRYING DREDGER, SEINE NAVIGATION, FRANCE.

ends; these are supplied with steam from an auxiliary boiler. Another steam winch serves to work the sluice valves and the suction pipe. The auxiliary boiler in question is multitubular, and supplies not only the winches, but also gives steam for the electric lighting of the boat and for heating the various berths. The electric-lighting equipment serves to facilitate night work; three arc lamps of 1,000 candle power each are provided on deck for this purpose.

These dredges give full satisfaction. They were to draw each 17,658 cubic feet in 50 minutes; their traveling speed in a rolling swell of 15 inches was specified to be 8 knots, with a coal consumption of 1.87 pounds per indicated horse power per hour. During the tests, the wells were filled in 38 minutes; the speed reached was 8½ knots, with a coal consumption of 1.70 pounds only.

We hear that the Societé des Anciens Etablissements Satre have recently booked an order for seven similar suction dredgers for the Montevideo harbor works. —We are indebted to London Engineering for the engravings and article.

LIVING WATER FOR JERUSALEM.

MANY people will be interested to learn that at last an actual beginning has been made to bring a supply of living water into Jerusalem, says the London Times. The remains of ancient aqueducts and reservoirs testify to the abundant provision which the Holy City had when it flourished as the metropolis of the Jewish State. But it has now long been dependent on the scanty and often polluted accumulations of rain water from the terraces of different houses gathered in the rock-hewn cisterns beneath them. When there is an abundant rainfall the cisterns are all filled and yield a moderate supply. Even then, in the end of the summer, water becomes scarce, and there is annually no little distress from its lack, and much fever and other sickness caused by the use of the dregs of the cisterns. But in the event of a small rainfall, the distress is most acute and begins early in the summer. The rainfall of the past season was only about 15 inches, which is but half the average of the past few years. In consequence there is already not only a dearth of water for household purposes, but the extensive building operations which form a chief source of employment to the artisans and laborers have had to be suspended, which has deprived thousands of employment.

For many years no little effort has been made by the rich and influential friends of Jerusalem, both Gentile and Jewish, to secure for it an adequate water supply. About thirty years ago General Sir Charles Warren, who was then making explorations here for the Palestine Exploration Fund, agitated the question, which resulted in Lady Burdett-Coutts offering the £50,000 then said to be required to bring water from Ain Arroub, which is beyond Solomon's Pools and about sixteen miles south of Jerusalem. The Turkish government was unwilling to accept the offer on the conditions which accompanied it, which prevented the plan from being carried out. Likewise also, and for the same reason, the efforts of a London committee composed of friends of Jerusalem, who also have long had the needed amount in hand, were fruitless.

It is interesting to note the combination of circumstances which have contributed to bring about the work just now inaugurated. The first of these has been the insufficient rainfall of the past season and the fact that Jerusalem stood facing a water famine. Another factor has been the recent arrival of the new Governor of Jerusalem, his Excellency Mohammed Djevad Pasha, who found the municipality endeavoring to meet the emergency by having a daily supply of water for the poor brought in by the railroad company, to be sold at a small fixed price per skin. Of further help was the opportune presence in Jerusalem on a visit of Franghia Effendi, one of the Sultan's engineers, who suggested to the governor the plan of at once laying a pipe to Jerusalem from Ain Salah, or the "Sealed Fountain" at Solomon's Pools, about nine miles south of the city, which could be accomplished in a few months' time, at a cost of £5,000, and would deliver about 8,000 skins every 24 hours.

There was in existence a fund or endowment, dating several centuries back, for giving Jerusalem a water supply, the income of which has hitherto been diverted into other channels. On the Mohammedan feast of the birthday of the Prophet, the new governor, in telegraphing his congratulations to his Imperial Majesty the Sultan, asked that the occasion might be signalized by permission to appropriate from this fund the amount needed to bring in the water in the way mentioned. The reply was favorable, and on July 5, about 5 o'clock in the afternoon, the laying of the foundation-stone took place at the Pools of Solomon, in the presence of the civil and military pashas, the Mohammedan religious heads and a number of other leading Turkish officials. Representatives of the Latin, Greek and other Jerusalem religious communities were invited, but the shortness of the notice prevented the attendance of several. The Pasha laid the corner-stone, and the traditional lambs were slaughtered, and prayers were offered. The flesh of the two lambs was divided on the spot by the poor among themselves, according to custom.

The work, thus begun, is that of laying a pipe of 10 c. in diameter from the Sealed Fountain to Jerusalem. This fountain is supposed to be the work of Solomon, and to be alluded to in the Song of Solomon in the words, "My beloved is like a spring shut up, a fountain sealed." It is a deep-down subterranean spring, which has, from the time of Solomon, flowed through the arched tunnel built by him to the distributing chamber or reservoir near the northwest corner of the highest of Solomon's Pools. Half a century ago the location of this "hidden" spring, which was still, as in Solomon's time, flowing into the reservoir mentioned, was unknown. The tunnel is roofed by stones leaning against each other like an inverted V, the primitive form of the arch, which is also seen in the roof of the Queen's Chamber of the Great Pyramid. The entrance to this tunnel from the spring is one of the oldest structures in existence. The piping is to be laid along the old aqueduct which formerly, from the time of Solomon, brought this same water to the Temple area. It will require about 20,000 meters or 20 kilometers of piping, and several English and Continental firms have just been telegraphed to for offers to supply the piping required. The course of the aqueduct is down the valley in which Solomon's Pools are built. Just below the lower pool the waters of Ain Etam join and augment the flow from the Sealed Fountain. At a little distance further down the valley the beautiful site of the ancient Gardens of Solomon, watered from these pools, is passed. The planting of these gardens, as well as the building of the pools of water, is mentioned by Solomon in the book of Ecclesiastes. Here now is Artas, a village in the still well-watered and fruitful valley. Here also has just been erected a Roman Catholic convent, built by a South American bishop at a cost of £15,000, where the nuns of the order of the Daughters of Solomon will conduct a school for Armenian Catholic orphans. Further on, the course of the aqueduct passes Bethlehem, and on northward past Tantour, where live the successors of the real order of the Knights of St. John, past Mar Elias, where Elijah is said to have rested in his flight from Jezebel; then it crosses the historic plain of Rephaim, where David, in the heat of the battle with the Philistines, longed for water from the well at Bethlehem, and finally, after passing around the slope of Zion, it enters the city through the grounds of the mosque of Omar, the old Temple area.

There are eleven or twelve ancient fountains here and there in the city, long unused, but now to be utilized, and from which the water may be drawn, free to all, several taps being attached to each fountain.

His Excellency Mohammed Djevad Pasha shows the keenest interest in this work, and is also making inquiries into the feasibility of bringing an additional supply of water from Beeroth, which name means "the place of wells," whence it is said water was brought in ancient times to Jerusalem. From this source, at a cost, it is said, of about £8,000, a supply of spring water, similar in quantity to that from the Sealed Fountain on the south, can be readily had.

Another work of interest is the successful repairing of the Virgin's Fount in the Valley of Jehoshaphat, just outside the city walls. This is a fountain of brackish water with a small intermittent flow. That is to say, after several hours' flow there occurs a short interval during which the water ceases. It is the only fountain which Jerusalem possesses. Its waters pass to the Pool of Siloam through a tunnel built by Hezekiah, as was recorded by his workmen on the rock-hewn wall of the tunnel in rude Hebrew, forming the oldest Hebrew inscription extant. A few years ago this inscription was surreptitiously cut out from its place and stolen, but was recovered by the Turkish authorities before it had been taken out of the country, and is now one of the most interesting objects in the Constantinople museum. About the same time efforts were made by blasting to increase the flow of water from the fountain, which resulted in a greatly diminished flow, and in its ceasing altogether in the summer months. Some Siloam villagers undertook to restore the spring to its former effectiveness, for which they were to receive from the municipality 100 napoleons if successful. They found and closed the breaks through which the water was lost, and it is now flowing as formerly, to the great joy of the Siloam people, whose chief source of supply it was.

THE DAVID SELECTOR AND THE METALLURGY OF COPPER.

AFTER prolonged trials success has been obtained in the application of the Bessemer process to the metallurgy of copper through the use of the converter with horizontal tuyeres. This apparatus permits of converting the matt coming from the furnace into metallic copper, but it has numerous drawbacks, and is capable of only incompletely eliminating the impurities that are met with in cupreous materials, especially in ores containing precious metals. M. P. David, directing engineer of the Société des Cuivres de France, has solved the problem through the invention of the "Selector," which, in a single operation, produces both the cupreous "bottom" containing the impurities of the matt and of the foreign metals and purified copper in a metallic state.

This selector has a spherical form in order that the action of the air from the blower may be distributed regularly and in such a way as to prevent projections of matt, and, besides, in order to assure a more regular wear of the lining, which furnishes the silica necessary for the scorification of the iron present in the ores. The tuyeres are arranged at the bottom of the apparatus according to the generatrices of a hyperboloid, so that the air traverses the entire bath and involves a rapid oxidation.

From Fig. 3, Nos. 1 and 2, it will be seen that the apparatus is movable around a journal, C, which is hollow and serves as a conduit for the air under pressure. This air follows a conduit, D, enters the windbox, E, and is distributed through the tuyeres. When need be the revolution of the apparatus is produced by means of a winch, M, a screw, V, and a spur wheel, R. The entire apparatus rolls in a circle, H, through the intermedium of wheels, B. Let us note as very characteristic the existence of a conical pocket, B, that serves for collecting and removing the cupreous bottom, so as to leave nothing but the purified matt in the selector.

In Fig. 3, No. 3, is given a diagrammatic sketch that will permit of understanding the different phases of the treatment of the ore. At 1 the selector is brought before the furnace and there is placed in its mouth an iron plate channel which is lined with fire clay and ends at the crucible in which the matt is placed. The latter is drawn off by opening the tap-hole. The charging must be arrested before the matt reaches the tuyeres. In this way it is possible in five minutes to bring the apparatus thus charged with a 25 or 35 per cent matt under the hood where the blowing is effected. Then comes the second phase in which the hollow journal is connected with the air intake pipe. Of course, the apparatus is righted so that the air from the tuyeres may enter the matt, the sulphurous gases may be disengaged through the hood and the scoria of silicate of iron may remain melted upon the matt. In about twenty minutes the entire scorification will have terminated and the flame have become bluish. The third phase is the drawing off of the

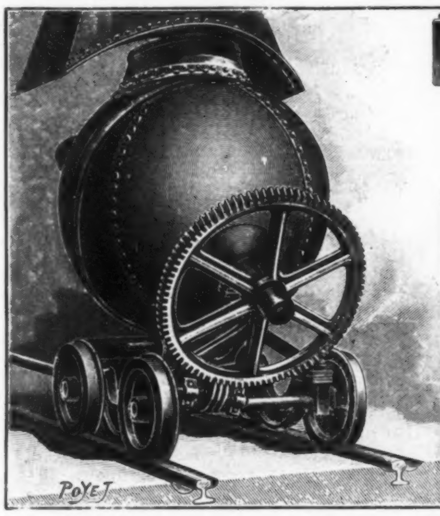


FIG. 1.—REAR VIEW OF THE DAVID SELECTOR

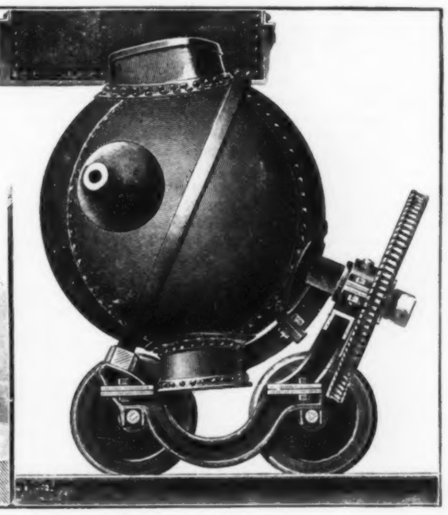


FIG. 2.—SIDE VIEW.

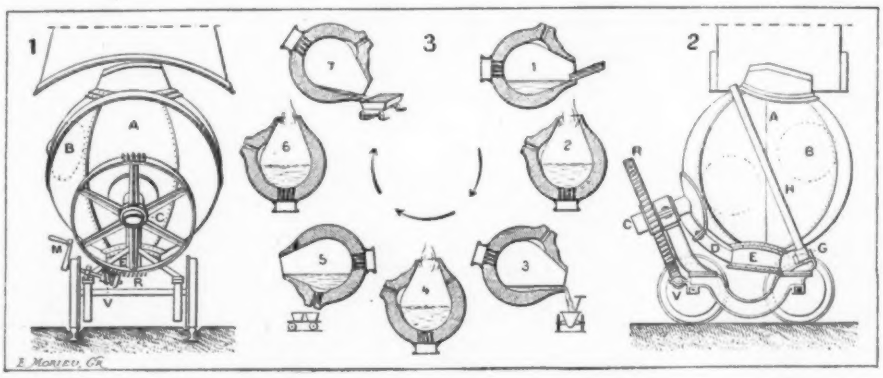


FIG. 3.—1. BACK VIEW OF THE SELECTOR. 2. PROFILE SECTION. 3. DIFFERENT PHASES OF THE TREATMENT OF ORE.

scoria (which is very fluid) by inclining the selector, and finally scraping off the last layer.

There remains in the selector some sulphide of copper mixed with other sulphides (gold, nickel, tin, etc.) which has to be got rid of in phase 4 by righting the apparatus and continuing the operation. The sulphides become decomposed, their metals unite in ten minutes at the most with the copper already formed, and an impure copper or cupreous bottom is obtained. It is then that the fifth phase occurs. The selector is turned to a position opposite that in which it was placed in phase 3, the molten metal is decanted into the pocket and is drawn off by piercing the fire clay lining with a tool. The aperture is afterward plugged with clay, when the matt begins to appear. Afterward the pure copper must be formed (phase 6); that is to say, the sulphide must be transformed. The selector is righted, the sulphur burns, a portion of the copper becomes oxidized, the oxide and sulphur mutually react upon each other, and there finally remains a metal containing from 98 to 99.5 per cent of copper, at the end of 12 or 15 minutes, at which period a dark red flame appears.

The last phase is the drawing off of the copper into ingot molds by inverting the apparatus. This invention is so much the more interesting in that the apparatus working even as a simple converter is of undoubted superiority to others. The duration of an operation depends upon the richness, purity and weight of the matt treated; but, supposing, for example, a 30 or 35 per cent impure and poor matt and a selector treating 3,300 pounds, it will take from 60 to 80 minutes to perform the complete operation. An apparatus working under such conditions will treat from 15 to 20 tons of matt per 24 hours.—For the above particulars and engravings we are indebted to La Nature.

NEED OF DIRECT STEAMSHIP SERVICE TO AFRICA.

THE desire on the part of American manufacturers to extend their trade to foreign countries has caused many of them to scatter letters and circulars broadcast, with a view to advertising their goods, and lack of success does not seem to abate their persistency. That the senders of these circulars do not comprehend trade conditions outside of their own country is shown by the fact that they frequently express disappointment because their communications do not receive prompt attention, although as a rule these are not printed in the language of the countries to which they are sent.

But more serious than the attempted use of the English language for commercial purposes in countries where it is not current is the fact that many American manufacturers have apparently such confidence in the superiority of their goods over those of foreign make that they think it unnecessary to make any effort toward introducing them to foreign customers beyond sending them by rail to one of our seaports, and they accordingly quote their goods at prices in American currency "free on board," payable in drafts at short sight on delivery of the goods at New York.

The assumption seems to be that when the quality of the goods becomes known, through advertising in English in countries where the English language is not understood, foreign dealers will feel impelled to send for them, no matter how difficult and expensive the transit may be after the goods have left the United States, and no matter what advantages foreign exporters of the same classes of goods may be inclined to give. The superiority of American goods to those of foreign make has been emphasized so much of late that the effect has actually been misleading to many who wish to export, and has caused disappointments which might have been avoided, if the subject in hand had been better understood.

The prices quoted by our manufacturers "free on board" at New York might not in most cases be too dear for successful competition in new countries, where development is progressing rapidly, if means existed to transport the goods in American steamers by the most direct route to the countries where they are needed. Most unfortunately for the healthful development of American commerce with new countries, this is not the case. There are several fine steam lines (nearly all of them in the hands of foreigners and managed in the first place to suit the views and interests of foreigners) between ports of America and Europe; and some of the principal ports of Europe have efficient steam lines—managed exclusively in the interests of the countries which sustain them—direct to the new countries where manufactured goods are greatly needed, and where they bring the last and highest price. When the steamers belonging to these lines lack cargo from the countries to which they belong, their managers are of course not averse to receiving the goods of their competitors, which have already stood many extra expenses, besides paying a transatlantic freight; and in this way, by making precarious and always costly connections, American goods can eventually reach their destination. They are often carried nearly 3,000 miles out of their way, and they are handled and levied upon to the end of their circuitous route by foreigners, who as a rule have no desire that they shall succeed. How can it be expected that American commerce will have the development that it deserves in new countries, where manufactured goods are not produced but where they are greatly needed, when nothing is done to change conditions which threaten even the continuance of the trade we already have?

I know it is contended that under conditions as they exist, commerce in America has nothing to complain of; that our exports have lately been vastly in excess of our imports in value; and that if foreigners can do our freighting cheaper than we can, while our capital is better employed in developing the resources of our own vast country, the best way is to let them do it. There is no doubt a fraction of truth in these assertions, but they are far from covering the whole ground. Complacency may be natural while we contemplate our natural resources, but it need not blunt our sense of proportion. As one of the biggest countries on earth, we may need a share in the trade of vast regions of the globe where manufacturing will not be carried on for perhaps a century, as well as smaller nations, which are aiming by means of their shipping facilities to practically exclude us from such markets. The United States is almost as near the tropical and south temperate parts of Africa as Europe is, and yet, according to the latest estimates, has scarcely 5 per cent of its import trade.

And if our competitors who now do our freighting manage it so as to keep our manufactures from the best, because the newest, markets, while they import our excess of food products in order to feed their competing operatives cheaply, the result in time may not be gratifying to our pride. While we are thus swallowing the bait of a temporary prosperity, our wary competitors are intrenching themselves politically as well as commercially in regions which will take their goods for centuries, and, more and more as time goes by, furnish them with food in return, to the exclusion of the products now exported by us. This may sound strange to some, but this country now abounds in cornfields as rank in growth as any which could be found in America; its swamps produce rice which, if cultivated extensively, would yield enough for exports on the largest scale; and beef animals are so abundant that sirloin steak is supplied at only 15 cents a pound.

We might easily gain and maintain a respectable footing in this great market, if we had well-appointed steamers under the American flag to bring our goods direct to it, and to receive such of the products of Africa as are wanted by our manufacturers in return. If this is done without an unnecessary loss of time, it may quickly change the value of our trade with these parts of Africa from 5 to 15 or 20 per cent of the whole; but if direct communication under the American flag is not soon established with Africa, there are many reasons for believing that we shall not in the future maintain even our present poor ratio of 5 per cent of the trade of a country almost three times the size of Europe, as easily accessible to us, and of probably far greater resources. I will here mention a few of the causes why, without steamers of our own, we shall probably not retain our present insignificant share of the traffic.

Europeans who are established politically as well as commercially in Africa generally commence their custom-house regulations by putting a small export tax on produce, which, as the burden comes alike to all, does not excite apprehension or comment in any quarter. Records are also kept of the movements of vessels, ostensibly for the purpose of acquiring statistics, but in reality the object is to get the coast line under the commercial control of the nations which establish the apparently harmless custom-houses. This is usually accomplished by the time fortifications are erected which command the seaports, and the natives who inhabit the coasts and seaports are brought first under military and then under complete civil control. A modest import duty of about 5 per cent on all goods arriving is then imposed; but as this is burdensome to none, it is also esteemed fair. A few years serve to confirm each nation in the rights it has claimed, and then the regulations are cautiously begun which exclude countries situated like the United States—with no ships of their own visiting the country, no merchants striving intelligently to open trade with it, and no consuls who are equipped to promote the interests of their compatriots—from their legitimate share in the trade. Extra duties are charged on goods not produced in the countries which claim the colonies, not at first to the point of prohibition, but capable of being extended in that way. The port charges for vessels are arranged so as to bear hard on all but steam lines, and so it happens that if an American sailing vessel should come here now, with a general cargo, she would be obliged to pay 1 franc (19.3 cents) a ton on her registered tonnage for the privilege of discharging it, while a steam liner from Europe would pay nothing.

The colonies in Africa are also, to an extent, being exploited by mercantile companies which have their principal places of business in the cities of Europe, and these companies are largely, in their very organization, inimical to American interests. One shareholder may be a soap manufacturer in Marseilles, interested that the factories of his company in the colony shall not buy American soap; another shareholder may be a cotton manufacturer in Flers or Manchester, and interested that the company shall not buy American cotton goods; and another may be a lumber merchant in Norway, interested that the company shall not deal in American lumber. Thus the governments, merchants, manufacturers, and shipowners of Europe are in accord on the subject of keeping Americans away from this richest of countries, the development of which they hope to enjoy for ages. Only a few years since (in the days of sail), Americans had the same right here commercially as others, and were not backward in exercising it. How is it then that they have so quickly lost all or nearly all? In my opinion, it is simply because they have as a nation neglected their ocean-carrying trade and allowed unsympathetic foreigners to attend to what should have been their own first business.

Previous to 1870, the west coast of Africa was connected with Europe, as well as with America, principally by sail, and as long as this state of things existed Americans held their own in Africa, and had perhaps, all things considered, their full share of its budding trade. The American flag was then never absent from the coast. American goods were known everywhere and liked, and fortunes were made by Americans doing business in this way. But the advent of steam has changed all this. The French Government first heavily subsidized the Messageries Maritimes Company, in order to have the large and fine steamers which ply fortnightly between Bordeaux and Brazil stop at Dakar. The Transport Maritime Line from Marseilles followed, its steamers also making fortnightly trips. Then came in quick succession the Chargeurs Reunis Line from Havre, the Fraissinat Line from Marseilles, and the Ligne Mixte. Cables were laid along the coast of Africa to facilitate the business of these government-assisted lines, and sail almost disappeared from the coast. The great Elder, Dempster Company, of Liverpool, England, also established a fortnightly service between Liverpool and this part of the coast, and the Woerman line of steamers from Hamburg kept the interests of the German merchants and manufacturers on as sure a footing as the others.

With all these first-class facilities for commerce, Americans, by sail and without subsidies, could of course not compete. So after keeping up a running fight for a few years with tobacco, petroleum, pitch-pine lumber, and a few other articles peculiarly American—until Europeans themselves began to bring the two former by steam in quantities as wanted—the American merchants were obliged to own themselves beaten, and one by one their vessels were withdrawn from the trade. Tens of thousands of tons of goods, with which Americans could successfully compete if they had steamers of their own, are being distributed here; but in the midst of all this activity, no one could tell from appearances that such a country as the United States exists. I see scores of European steamers coming and going, loading and discharging almost every week; but during a residence of more than twenty years in the country, I have never yet seen an American merchant steamer in African waters.

Here are railroads being built and equipped, millions of natives being clothed and otherwise provided with the appliances of civilization, wharves, bridges, and docks being constructed, and electric plants and appliances being introduced, while we are taking no part in the furnishing of all these things.

But it may be asked: If the trade of Africa is so desirable, why did not the American merchants who formerly did business here and used sail for transport, organize steam lines like their European competitors for the continuation of their business? To answer this question it is only necessary to say that, as Americans have not thought themselves able to do it with the old countries on the east side of the Atlantic, nor with South America, how can it be expected that they should succeed in such an enterprise where the conditions would be more difficult? The 150,000,000 people in Africa do not need our bulky grain, nor our cotton, nor our animals, either slaughtered or on the hoof, but they do need our flour, our biscuits, our indian-corn meal, our cotton goods, our hams, preserved meats, fish, vegetables, boots and shoes, tools, machinery and locomotives, with hundreds of other things I need not mention, nearly all of which are furnished by Europe, even though the country of their origin be the United States. What is needed is the means of getting our goods here under American control.

Many Americans may say that our country is at present enjoying very good times without African trade, but the letters and circulars mentioned at the commencement of this report make it evident that others are apprehensive that without a fairer chance in the world's markets, their exceptionally good times may not last. The welfare of our manufacturers requires that good lines of steamers under the American flag should be established immediately between the United States, Africa, South America, and all other large countries where development is progressing, at whatever cost.

In order to connect the United States well with Africa (except the Barbary States and Egypt), there should be perhaps two lines of steamers, one to ply between some port in the northeastern States—presumably Boston—and the countries of Africa between Cape Verde and Loanda, taking in St. Vincent, in the Cape Verde Islands. The other line might start, say, from New York and take in the countries between Loanda and Zanzibar, including a port in Madagascar. The steamers of both these lines should be well equipped for mails and passengers, and subsidized to an extent which should lead to their immediate establishment and serve to maintain them against the competition of rival foreign lines, as nothing is more certain than that a determined effort would immediately be made to "run them off."

The first steamers should sail, I think, monthly, and stop at one port in each colony or country between Cape Verde and Loanda. There is no port of importance which can be entered by large steamers between Cape Verde and Morocco. The first port for the northern line to make, after leaving America, would be St. Vincent, which is important as a coaling station and is also an entrepôt for considerable commerce. The next port would be Gorée or Dakar; then Bathurst, Bissau, Konakry, Sierra Leone, Monrovia, Grand Bassam, and so on, one port in each colony to Loanda. Each steamer, in going and returning, would spend a little more than two months on the coast, and perhaps three months and a half in making a complete voyage. This would include perhaps six or seven steamers for the northern line, in order to insure monthly trips—a modest number, surely, when it is reflected that the Elder, Dempster Company, of Liverpool, alone has more than sixty steamers on its advertised list, which cover the same route.

The first steamers should be, I think, of 2,500 or 3,000 tons gross and capable of making at least 12 knots. There would immediately be a large amount of freight and some passengers for such a line of steamers, and both would increase after establishment in almost a geometrical ratio. All the American goods which now pass through Europe on their way here (going nearly 2,500 miles out of their course and paying about 25s.=$6.25 per ton extra) would be sent direct; and as soon as trade could be organized so as to profit by the new conditions, it is possible that the number of steamers would have to be increased and their sailings made more frequent. It is very likely that such a line of steamers would more than double the amount of American goods at present exported to this country and greatly increase the variety within a year.

But there is no question that without help from the government, no line of steamers under the American flag could exist on this coast. Since our necessary expenses would be greater, one could hardly exist if foreign steamers were not subsidized; and all the odds are allowed to be against our merchants and shipowners. And this brings us again to the question whether it is safe and best to make our own coast line our counter for our manufactured goods, or whether it is not vastly better to imitate our rivals in seeking out the consumer wherever he may be found, with all the means and appliances for giving him satisfaction wholly under our own control. The facilities will

is a disputed point, though recently it has been believed by many to be the grist of ancient glaciers. Prof. Wright and his son made a long journey along the edge of the Mongolian border back of Kalgan to find the signs of the former glaciers which must have covered the region, if that theory were correct. No indications of former ice sheets, however, could be found. A similar condition of things exists 2,000 miles to the westward in Turkestan, on the other side of the great Asiatic plateau. The conclusion is that the loess originated, as Von Richtofen contended, in the arid regions of Central Asia and Turkestan in the slow disintegration of the surface rocks, and that it was carried by the wind to the mountain regions on the border of the plateau. Prof. Wright infers from the present distribution of the loess in apparent terraces around this mountain border and from its occasional great expanse in level areas that there has been a recent subsidence of the land, so that the waters of the ocean extended far inland and that this was connected with great increase of rainfall, washing the material down to water level and depositing it in the positions in which it is now found. In conformation of this are the many evidences, both geological and historical, that the Desert of Gobi was recently filled with water, making an inland sea as large as the Mediterranean.

The recency of certain great geological changes in Central Asia is proved by the existence of Tertiary rocks at high elevations, sometimes as high as 10,000 or 12,000 feet, and by many other facts, the most interesting of which relate to Lake Baikal. This lake is 400 miles long and averages 30 miles broad. It lies in a north and south line on the western side of the Vitim plateau, which is 5,000 feet above the sea and 300 miles broad, forming the great divide of Eastern Siberia. The southern half of the lake is 4,189 feet deep, while the surface is but 1,260 feet above the sea. The Selenga River emptying into the lake on the east about 100 miles from the southern end drains an area of 200,000 square miles. The drainage troughs of erosion in the Selenga and its branches are miles in breadth and many hundred feet deep, and were mainly eroded before Middle Tertiary times, since Tertiary sedimentary strata occur along their bottoms for great distances. During all this early period of erosion Lake Baikal did not exist, but the Selenga River continued across its site to join the Angara, where that river now emerges from the west side. The material carried away during that period was deposited in a shallow sea which then extended thirty miles east of Irkutsk and formed the extensive Triassic and Tertiary strata which now cover a wide area in that valley and contain several coal seams. The bottom of the southern end of Lake Baikal therefore began to settle down in late Tertiary times, and the period since that time has been so short that the Selenga River has not had time to fill the basin with sediment. The approximate length of this time can be obtained by calculating the size of the basin and the rate of sedimentation. The southern end of the lake basin is calculated to contain 4,000 cubic miles, on a liberal estimate, so that if the Selenga River wears down its drainage basin as rapidly as the Mississippi does its area, 40 cubic miles of sediment would be carried into the lake every 5,000 years, which would entirely fill the basin in 500,000 years. But the basin is certainly not more than one-fifth full, and is probably not more than one-tenth, hence the changes which have produced the basin at the southern end of Lake Baikal cannot have occurred more than 100,000 years ago, and probably not more than 50,000. Prof. Wright's papers were illustrated by lantern slides.

Prof. T. C. Chamberlin delivered two masterly papers which it is practically impossible to present in abstract. They were on the "Distribution of the Internal Heat of the Earth" and on the question: "Has the Rate of Rotation of the Earth Changed Appreciably During Geological History?" The author said that his answer to the question would be that there probably had been no effective diminution in the rate of rotation within geologic time. The other papers which were read were: "The Areal Distribution of the Potomac Group in Maryland," by W. B. Clark and A. Bibbins; "The Regeneration of Plastic Feldspar," by N. H. Winchell; "The Effect of Shore-line on Waves," by W. M. Davis; "Some Anticlinal Folds," by T. C. Hopkins and M. Smallwood; "On the Use of the Terms Linden and Clifton in Geologic Nomenclature," and "Further Observations on the Cincinnati Anticline," by A. F. Foerste; "Note on the Catalogue of Types and Figured Specimens in the Geological Department of the American Museum of Natural History," by E. O. Hovey; "On the Middle Carboniferous Strata in Nova Scotia and New Brunswick," by H. M. Ami; "Observations on the Marcellus Fauna of Central New York," by J. M. Clarke.

[Continued from SUPPLEMENT No. 1358, page 21767.]

ANNUAL REPORT OF THE SECRETARY OF AGRICULTURE, 1901.

IRRIGATION MATTERS.

THE Secretary devotes a great deal of space to a discussion of irrigation investigations. These have been conducted through the Office of Experiment Stations, and embrace (1) studies of irrigation laws and the social and industrial institutions of irrigated agriculture; (2) investigations of the methods by which water is conserved, distributed and used.

Titles to Water.—In reference to the first subject the Secretary states that the character of the titles to water finally recognized will do more than all other influences combined to determine whether the Western farmers ought to be tenants or proprietors. Naturally, this makes the disposal of the watering sources of the West a matter of vital importance not only to the persons directly interested, but to the country at large. Every consideration which justified the general government in the control, the survey, and disposal of public lands, applies to the orderly and just establishment of titles to water by public authority, either State or National. He points out the confusion and trouble and almost endless litigation frequently attending the settlement of this question, and declares it to be absolutely necessary that some simple and final method of determining and protecting rights to streams should be provided. In the meantime the conditions, as they exist in arid States, are being carefully studied by the Department.

Improved Instruments.—Irrigation experts of the Department have designed improved instruments for measuring water, by which registers are now furnished to irrigators at about one-half the cost of the foreign instruments.

Irrigation in Humid Regions.—Attention is directed to the growth of irrigation in the humid regions, and the remarkable fact is stated that in Louisiana more money has been expended on pumping-plants in the past two years than in any arid State. By irrigation, rice-growing in Louisiana and Texas has raised the price of land originally worth $5 to $10 per acre to $50 and even $100 per acre.

Legislation by Congress.—The Secretary expresses the belief that irrigation will, in the near future, become a subject for legislation by Congress, there being important reasons why it should have the attention of that body. At the same time, he says that those best informed believe that the uncertain character of water rights can only be remedied by a larger measure of public control and the making of certain classes of irrigation structures permanently public works. These, it is urged, should not be owned by private parties, and the argument produced in favor of constructing reservoirs by act of Congress is the same which justifies setting aside forest reserves and the maintaining of a force to control them. On the other hand, the Secretary points out that an appropriation of money by Congress to construct such irrigation works will bring the country face to face with a new government policy and will carry a larger measure of public control over the water resources of the West than has hitherto prevailed or been sanctioned by public sentiment.

Land Laws Affecting Irrigation.—He reviews the influence of land laws on irrigation development, stating that laws which control the disposal of 500,000,000 acres of arid public lands must have a vital influence upon the success of irrigated agriculture. He condemns the desert-land act, stating that 640 acres is more land than a man of moderate means can cultivate under irrigation. Cutting down the entries from 640 to 320 acres is an improvement, but he believes in the entire repeal of the desert-land act and in requiring settlers or homesteaders to cultivate as well as live on their land.

The Grazing Lands.—Referring to the grazing lands, he says probably 400,000,000 acres of the public domain have no agricultural value except for pasturage. It is at present an open common, with no laws for its protection or disposal. He refers to the frequent conflicts of the farmers under irrigation with the range stockmen, and recommends, as a remedial and beneficial measure, the leasing of the grazing land in such a way as not to interfere with the homesteader. The rentals, he believes, would amount in the aggregate to a large sum, which could be appropriately applied to the reclamation of the irrigable lands. He points out that such leasing is not an experiment, as it has been successfully tried, although in a limited way, in Colorado, Idaho, Montana, Nebraska, Utah and Wyoming. He winds up the discussion of this subject by presenting the following conclusions:

1. That private enterprise will have to be supplemented by public aid in the construction of certain classes of irrigation works if we are to secure the largest development of Western agriculture.

2. That reservoirs located in the channels of running streams should be public works.

3. That the first step toward National aid for irrigation should be the passage of enlightened codes of water laws by the States to be benefited.

4. That the land laws should be modified by repealing the desert act and by requiring cultivation as well as residence on a homestead.

5. That the non-irrigable grazing lands should be leased in small tracts so as to unite the irrigable and the pasture lands.

WORK IN ENTOMOLOGY.

Under this head the Secretary reports the successful introduction and establishment in California of the fig-fertilizing insect, with the result that it has been thoroughly established at several points, and that the Division of Entomology is now ready to supply fig insects to any grower after he has succeeded in raising to the bearing stage, caprifig and Smyrna fig trees. The discovery is reported, by an expert of the Division sent to Asia for the purpose, that the San Jose scale is not indigenous to Japan, but that it is so in north China. It has been in a section of that country where there have been no fruit importations, and all fruits are of native sorts. Further, in this district, it was found to have a natural enemy—a ladybird beetle of which the expert in question has collected many specimens and forwarded them to Washington, and steps will be taken to acclimatize this important species. This importation will doubtless prove of extreme value to fruit-growers in this country. Another valuable importation of the ladybird beetle was of one which feeds upon several distinct species of plant lice accidentally imported into this country from Europe.

BIOLOGICAL SURVEY.

The Survey is engaged in mapping the natural boundaries of the crop belts of the country. Its aim is to furnish farmers with lists of products likely to be successful, so far as climatic conditions go, in different parts of the country. During the past season the work of mapping the life zones and crop belts has been continued, particularly in Texas and California. A fiber plant, closely related to the Mexican iste or Tampico plant, is found growing in great abundance over a large part of the arid Sonoran zone. In view of the great quantity of fiber of other species of agave imported into this country ($12,000,000 worth in 1900), the Texas species is likely to prove of great value.

In response to constant complaints, the Survey has prepared and distributed a circular of direction for the destruction of prairie-dogs, and is now conducting experiments in the Dakotas, Nebraska, Kansas and Texas, with a view to discovering remedial measures against this pest, cheap enough for general use. It has been discovered that the bullock oriole and the California least tit feed extensively on the orange and olive. In Texas, the large blackbirds, known as jackdaws, and which have been slaughtered in great numbers for the millinery trade, are particularly useful owing to their feeding habits in the rice and cabbage-growing districts. In addition to its other duties, the Survey is charged with the general supervision of matters relating to game protection. In aid of the preservation of native birds and game it has published bulletins on the laws governing the transportation and sale of game, digests of State game laws, etc. Carrying out the provisions of the Lacey act, the Secretary acknowledges his obligations to three other executive departments, the Treasury, Interior and Justice, to several railroad and express companies, and to many State officials and individuals. Under the system of permits established for the transportation of foreign wild animals and birds, 186 permits were issued during the year, covering the entry of 350 animals and nearly 10,000 birds. Numerous violations of the laws regulating interstate commerce and game have been reported to the Department and in many instances it has been called upon to assist in prosecuting the offenders.

THE DIVISION OF STATISTICS.

The work of this Division consists largely in the preparation of reports relative to the principal products of the soil, including the extent and geographical distribution of the area of production, the condition and prospects of the crops during the growing season, and the quantity, quality and disposition of the products harvested. It has included also reports on various branches of rural economics, such as transportation, wages of farm labor, cooperation in agricultural industries, etc. An urgent demand exists for broadening the scope of the work of this Division. But this cannot be done without enlarging its appropriations. Telegraphic interchange of crop reports has been arranged for with the governments of some of the principal grain-growing countries of Europe. In furtherance of the plan to place the crop reports in the hands of the farmers as early as possible, a system of cards containing the most important points of the statistician's monthly report has been adopted. These cards are mailed promptly after the publication of the telegraphic summary to postmasters throughout the country with the request that they be promptly displayed in their offices. The Secretary recommends the enlargement of the Division under Bureau organization.

PUBLIC ROADS.

In establishing an Office of Public Road Inquiries, the object was to promote the improvement of public roads throughout the country. Efforts were first directed to ascertain the condition of the roads, the state of public opinion in regard to their improvement, the obstacles in the way, and the best methods to be employed in securing better roads—such has been the work of this office up to the present. For spreading information and awakening interest, nothing has been found so effectual as the "object-lesson," or sample roads, which, during the past year, have been built in nine States under the advice and supervision of the office. In building these sample roads, machines have been loaned by manufacturers and carried free by the railroad companies, while the local community furnishes material and labor. During the year, for the better carrying out of the work of the office, the United States was divided into four divisions, the eastern, middle, western and southern, each under a special agent.

PUBLICATIONS.

In the performance of its duty to diffuse the information acquired through its several Bureaus, Divisions and Offices, the main dependency is upon the issue and distribution of publications. This work, therefore, affords a fair reflex of the intelligence and activity of the investigating branches of the Department. The Secretary deplores the fact that this condition has not been as fully recognized in the appropriations as it should be, and the work of publication has, therefore, not kept pace with the wonderful growth and development of the Department. He deplores particularly the unavoidable suspension toward the close of the year of the work of both printing and distribution, and that no less than thirty-five worthy employés had to suffer distress by being furloughed through no fault of their own. Notwithstanding these restrictions, there were issued during the year 606 separate publications, aggregating nearly 8,000,000 copies. Nearly 3,500,000 copies were Farmers' Bulletins, of which two-thirds in round numbers were distributed under Congressional orders. With the increased appropriation and the accumulated copies, this year's supply of these bulletins will, under the present law, which assigns four-fifths, instead of two-thirds, to the use of Congressmen, make the allowance of each Senator, Representative and Delegate 15,000 copies. A special building has been rented to be devoted exclusively to the storage and shipment of Farmers' Bulletins, of which not less than 7,000,000 will have to be printed this year. The amount provided, however, for material and labor in their distribution is quite inadequate and must be supplemented by a special appropriation, if the demands of Congressmen are to be met. Referring to the great demand for the Year-book and the growth of the Department, the Secretary points out the inadequacy of the quota assigned the Department. When the edition of this work was 300,000 copies, 30,000 were placed at the disposal of the Department, the same as now, notwithstanding that the edition to-day is half a million copies. The demand for the publications of the Department continues to be greatly in excess of its ability to supply. Many of these—over 24,000 copies last year—were sold by the Superintendent of Documents. This is almost three times as many as the sales made by that officer of the publications of all other Departments of the government. A special appropriation has been asked for to carry on more effectively the work of illustration, which the condition of the appropriations in recent years has caused to be somewhat neglected. Over 140 persons are employed, including editors, proofreaders, artists, clerks and laborers, in the work of publication, and these are greatly hampered, owing

to their segregation in different buildings in crowded and inadequate quarters.

ACCESSIONS TO THE LIBRARY.

Over 4,000 books and pamphlets were added to the Library during the year. These included many books of special value in the work of the Department and a large number of scientific periodicals. Every effort is made in the Library of the Department to meet the demands occasioned by the constantly broadening fields of investigation entered upon by the Department, and to aid educational and scientific workers engaged elsewhere upon kindred work. The Department Library is regarded as the headquarters of agricultural literature, and should be able to meet demands from without as well as within the Department. The Secretary calls attention to the danger of destruction by fire of the 70,000 pamphlets and books now in the Library, owing to the character of the building at present occupied by the Department.

ACCOUNTS AND DISBURSEMENTS.

Congress appropriated $3,303,500 for the United States Department of Agriculture for the fiscal year ended June 30, 1901, being an increase of $558,920 over the appropriation for the preceding year. When all accounts shall have been finally settled the payments will amount to about $3,220,000.

The regular appropriation of $15,000 for each of the 48 agricultural experiment stations in the several States was also made.

On June 30, 1901, the unexpended balance of the appropriations for the year 1899, amounting to $28,899.27, was covered into the Treasury.

During the year $6,340 was paid for rental of leased buildings in Washington. Owing to inadequate accommodations, Congress, at the last session, provided for the lease of additional buildings, and the rental for the fiscal year 1899 will exceed $10,000.

EXPORTATION OF AGRICULTURAL PRODUCTS.

The highest record previously attained in the export of agricultural products—in 1898—was surpassed by over $90,000,000 in the fiscal year of 1901, when a value of over $950,000,000 was reached. Of the merchandise sent abroad during the year, 65 per cent originated on the farm. Of foreign customers for our agricultural products, the United Kingdom stands first, taking over 50 per cent. The next most important markets are afforded by Germany, France, the Netherlands and Belgium, in the order named. The Section of Foreign Markets has begun the preparation of a most comprehensive report on the character of our agricultural importations received by the United Kingdom, from countries other than the United States. The importance of this report is evidenced by the fact that, large as were our exports to the United Kingdom, they comprised only one-third of the foreign farm produce purchased by that country. Special statistics have been compiled by the Section of Foreign Markets relative to our trade in farm products with our new insular possessions. Our agricultural exports to Cuba, Porto Rico and the Philippines during the year comprised about 53 per cent of the domestic merchandise sent to these islands. Our imports of agricultural products from these islands exceeded our exports by just $30,000,000.

CONCLUSION.

The report concludes with a review of the development of agriculture and commerce during the past twenty years, and of the contributions by the Department of Agriculture to the progress of events and the building up of domestic and foreign trade. The Secretary says that coincident with this growth numerous institutions have grown up in this country and abroad, devoted to the application of science to the service of agriculture, [illegible] training, have developed such qualities as make them exceptionally valuable.

He concludes by saying that he would urge upon Congress, in the strongest terms and for the best interest of the country, such liberality as will enable him to obtain and retain the best men that can be found to fill the important places at his disposal.—Science.

TRAINS PARTED.

J. W. THOMAS, JR., general manager Nashville, Chattanooga & St. Louis, has sent us an instructive compilation showing the number and causes of trains parting upon that line for the year ending on July 31, 1901. The total number for the year was 817 and the causes are distributed as follows:

Draft timbers pulled out	87
Drawbar broke—in shank	96
Drawbar broke—top knuckle lug	56
Drawbar broke—through head	21
Drawbar broke—bottom knuckle lug	3
Knuckle broke	189
Knuckle opened	73
Knuckle pin broke	7
Knuckle lockpin broke	12
M. C. B. couplers parted	77
Key broke, continuous drawbar	59
Slip pin key broke	20
Slip pin key lost	23
Slip pin broke	78
Slip pin head pulled through end of drawbar	6
Yoke strap gave way	5
Yoke bolts broke	3
Link broke	2
Total	817

—Railway Age.

THE CHLOROPHYL RESPIRATION OF THE SPIROGYRAS.

IN water courses or in the stagnant water of marshes or pools we frequently meet with long green filaments that sometimes float upon the surface. Examined by the microscope each filament is seen to be composed of a series of cylindrical cells separated from each other by septa of cellulose. In each cell we perceive an elegant spiral formed of grains of chlorophyl, whence the name of spirogyra given to this multi-cellular alga.

1. Why do these filaments float freely upon the surface of the water? It is easy to see that the collection of filaments forming a sort of tissue is filled with bubbles of gas; and these may be collected by the following *modus operandi*: To the extremity of a stick secure a bottle closed with a rubber stopper

FIG. 2.—EXPERIMENT WITH GOLD FISH.

containing three apertures, one of which is traversed by the tube of a glass funnel. From the basin containing the spirogyras fill the bottle and the funnel and place the latter vertically. With another stick introduce a bundle of spirogyra and submerge it beneath the funnel. A brisk shaking will then cause a passage of the bubbles of gas inclosed in the funnel and bottle. Now transfer the gas from the funnel to a bell glass. If a match that presents but a few ignited points be placed in contact with the gas it will at once burst into flame, and thus show the presence of oxygen. The carbonic acid contained in solution in the water has, under the influence of the solar rays, been decomposed by the chlorophyl, which acts upon a wide surface, the carbon has been fixed by the plants and the oxygen has been set free.

This is a demonstration of chlorophyl action that presents no difficulty; but it is possible to devise a very simple arrangement that will permit of rendering the phenomenon continuous during summer days when the sun is shining brightly.

Into a bottle of about two quarts' capacity (Fig. 1), provided with two tubulures (one, *B*, at the top and the other, *A*, at the bottom) introduce water charged with carbonic acid and some filaments of spirogyra well washed and separated from any other plants. Care must be taken to place the bottle in a large glass vessel, *R*, filled with water in order to prevent the spirogyras from being burned by the solar rays.

The tubulure, *B*, is closed with a rubber stopper from which starts a tube that enters a vessel filled with water. The tubulure, *A*, also is closed with a rubber stopper, which is traversed by a straight glass tube connected by a rubber tube with the lower tubulure, *A*, of the bottle, *C*, containing water charged with carbonic acid. Now, pour several quarts of ordinary water into a vessel and pass into an inverted bell-glass 120 cubic inches of carbonic acid coming from a receptacle containing liquid carbonic acid. Upon raising the bell-glass and agitating it gradually in the water of the vessel, all the gas will be absorbed and there will be obtained a solution of carbonic acid which must be poured through a funnel into the bottle, *C*. A pinch-cock, *P*, permits of opening or closing the rubber tube. After a day's exposure to the sun the filaments of spirogyra will have become filled with bubbles of gas and will float at the upper part of the bottle. In order to unite these bubbles close the tube starting from the tubulure, *B*, with a rubber tube and glass rod and shake the bottle held horizontally. The bubbles of gas will then separate and soon unite at the upper part. Replacing the bottle vertically, collect in a graduated bell-glass, filled with water and placed above the outlet tube, the gas displaced by the flow of water from the bottle, *C*.

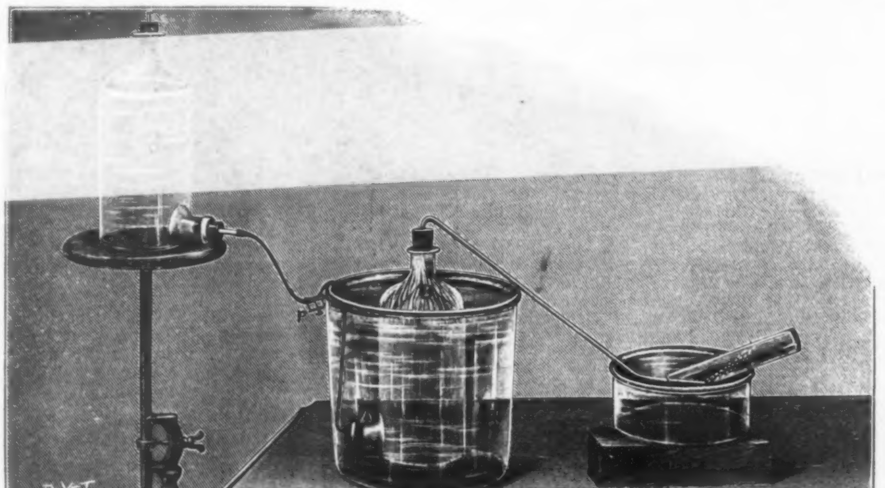


FIG. 1.—ARRANGEMENT FOR DEMONSTRATING THE ACTION OF CHLOROPHYL UPON SPIROGYRAS.

It is not a rare thing to obtain in this way 6 cubic inches of gas, which quickly relights an almost extinguished match, and which, when analyzed in a eudiometer, shows that it contains 85 per cent of oxygen. This experiment proves that plants provided with chlorophyl give up oxygen to the atmosphere through the decomposition of carbonic acid.

2. It is very easy, with animals and aquatic plants, to repeat the celebrated and very instructive experiment of Priestly. For this experiment, instead of employing leaves of *Potamogeton lucens*, we may use simply very green filaments of spirogyra.

Into each of two bottles, *A* and *B* (Fig. 2), containing a quart of ordinary water, without the addition of any carbonic acid, we introduce one or two gold fishes of about equal weight.

The bottle, *A*, contains pure water, while *B* has received in addition 225 grains of spirogyra weighed in a wet state and cut with scissors into filaments about three-quarters of an inch in length, so as to permit the fish to move freely. The bottles are submerged in an aquarium full of water and exposed to the sun. At the end of about two hours the fish placed in the first bottle will have lost its normal equilibrium and have turned over upon its side and ceased to breathe and will appear as if dead. The other fish will have preserved its normal attitude, and will be able to swim perfectly and respire with the greatest regularity.

The extraction of gases from the water by means of an apparatus based upon the use of the mercurial pump gave the following results:

Bottle A.		Bottle B.
0.95 cubic inch.	Carbonic acid.	0.33 cubic inch.
0.05 " "	Oxygen.	1 " "

Thus, in the spirogyra bottle, there was much less carbonic acid, say, 0.33 of a cubic inch, instead of 0.95 of a cubic inch, and much more oxygen, say, 1 cubic inch, instead of 0.05 of a cubic inch—enormous differences that show that, under the influence of the sun, 225 grains of spirogyra gave up a large quantity of oxygen to the water in which the fish lived in consequence of the decomposition of the carbonic acid.

These comparative experiments permit us to assert that it is well to preserve aquatic plants in water courses in order to maintain an environment favorable to the respiration of fishes and to furnish oxygen to the atmosphere.

Prof. Balbiani recommends the planting of trees along water courses so that the leaves in falling into the water shall give the infusion necessary for the life of the infusoria that serve for the food of young fishes during the early stages of their existence.

The illustrious chemist Boussingault directly demonstrated, in operating upon a grape vine covered with leaves, the decomposition of the carbonic acid of the air and the production of oxygen; so that aerial leaves operate like aquatic ones in order to maintain the normal composition of the atmosphere.—For the above particulars and the illustrations we are indebted to La Nature.

ORCHIDS THAT DRINK.

WHAT is probably the most extraordinary plant ever discovered has now been found by E. A. Suverkrop, of Philadelphia, says a correspondent of the Chicago Inter-Ocean, who, during trips to South America, has for some years been contributing to the collection of his friend, Prof. N. E. Brown, of the Herbarium, Kew Gardens, London. The amazing plant which Mr. Suverkrop has now found is an orchid that takes a drink whenever it feels thirsty by letting down a tube into the water, the tube, when not in use, being coiled up on top of the plant. "One hot afternoon," says Mr. Suverkrop, "I sat down under some brushwood at the side of a large lagoon on the Rio de la Plata. Near at hand was a forest of dead, shorn trees, which had actually been choked to death by orchids and climbing cacti. In front of me, and stretching over the water of the lagoon and about a foot above it, was a branch of one of these dead trees. Here and there clusters of common 'plantadel ayre' grew on it, and a network of green cacti twined round it. Among the orchids I noted one different from the rest, the leaves sharp, lancehead shaped, growing all around the root and radiating from it. From the center or axis of the plant hung a long, slender stem about ⅛ inch thick by ¼ inch wide, the lower end of which was in the water to a depth of

at 4 inches. I at once went over to examine my covery. Imagine my surprise, when I touched the nt, to see this center stem gradually contract and vulsively roll itself up in a spiral-like roll of tape. t more surprising yet was the object and construcn of this stem. I found on close examination and section that it was a long, slender, flat tube, the lls about 1-32 inch thick, cellular in construction, n at the outer end, and connected at the inner end the roots of a series of hair-like tubes. By subsement observation I found that when the plant was in nt of water this tube would gradually unwind till dipped into the water. Then it would slowly coil nd and wind up, carrying with it the amount of ter that that part of the tube which had been imrsed contained, until when the final coil was taken water was dumped, as it were, direct into the roots the plant. The coil remained in this position until plant required more water. Should the plant, howr, be touched while the tube is extended, the orchid s like the sensitive plant (mimosa) and the coiling more rapid. I found many of these plants, all ditly over the water or over where the water had n. In the latter case it was almost pitiful to see w this tube would work its way over the ground in rch of the water that was not."

AN APPARATUS FOR DETERMINING FAT.*

By H. J. Wheeler and B. L. Hartwell.

The Knorr apparatus† for the extraction of fat, which s a great improvement over preceding forms, en-

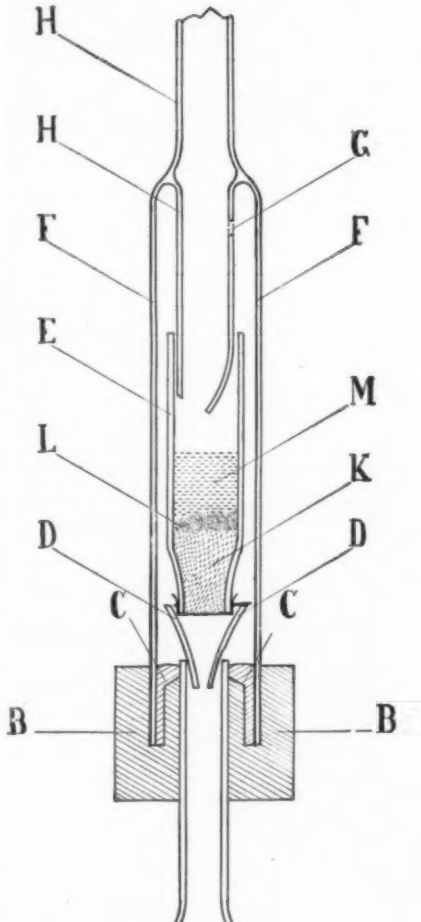


Fig. 1.

bled one to dispense with the ground glass and cork nnections formerly in use, by the employment of mercury seal.

The mercury is carried in a channel which encircles e neck of the flask at the base. In order to maintain e connection between the flask and the glass part mmediately above it, the two are held together by ibber bands. To avoid the use of the bands the conensers may be made movable so they can be lowered fficiently to connect with the flasks, or, if the conensers are stationary, the bath which supports the asks may be made movable. In many instances, parcularly in the case of batteries of considerable size, either of these plans is convenient, and, at the best, nless great care is exercised, the flasks are liable to eakage during the adjustment. The use of rubber nds is unsatisfactory owing to their liability to p or break.

A later modification of the Knorr flask was one hich had a glass channel attached to the neck of the sk near the top. This modification enabled one to reduce the quantity of ether liable to collect outside of the neck, but the flask was, necessarily, fragile and expensive. The apparatus described below was designed to remove some of the difficulties connected with that devised by Knorr and to accomplish certain other desirable objects. The improvements attempted may be summarized as follows:

1. The use of a simple flask which can be readily cleaned and replaced at small expense.
2. The employment of a rubber cup to carry the requisite amount of mercury for sealing and at the same time bind the flask firmly to the other parts of the apparatus.
3. The reduction to a minimum of the amount of ether which can collect around the outside of the neck of the flask, by the ready adjustment of the cup to any point upon the neck.
4. The bending of the end of the tube from which the liquid ether drops upon the substance which is undergoing extraction, so that the ether will be delivered from the center and not flow down the glass.
5. The prolongation of the tube mentioned in (4) so that it may support the upper ends of extraction tubes or thimbles of different lengths.
6. The collection of the ether in one receptacle at the end of the extraction without disconnecting the apparatus.
7. The maintenance of the ether in a dry condition.
8. The loss of the least possible amount of ether vapor during the extraction and at its close.

Below is given a description of an apparatus designed to meet the conditions just mentioned. This apparatus, made in accordance with our specifications, by Richards & Co., of New York, has already been in successful operation at considerable intervals for more than a year without apparent depreciation in the quality of the rubber cups and without the breakage of an extractor or other expensive glass parts.

Description of Apparatus (Fig. 1).

A. A plain flask of 50 to 60 c. c. capacity, having a straight neck.

B. A rubber cup channeled to carry mercury for sealing the connection between the flask and the lower portion (*F*) of the extractor.

C. A channel for mercury, showing the latter forced upward by the glass so as to cover the rubber, at the same time sealing the connection between the neck of the flask and the glass extractor which passes into the rubber cup at the outer margin of the channel.

D. A small funnel to conduct the ether and dissolved fat into the flask. This is grooved where it enters the neck of the flask so that the small amount of ether which accumulates between the neck and the extractor may flow downward.

Resting upon the funnel (*D*) is the thimble which contains the material (*K*) to be extracted. The bottom of this thimble is covered with fat-free filter-paper fastened to the outside of the thimble by means of wire. The ends of the wire rest upon the edge of the funnel so as to leave space for the passage upward of ether vapor.

L. Fat-free cotton to facilitate the distribution of the ether at the beginning of or during the extraction.

M. Ether, which is maintained above the substance (*K*) in considerable quantity during most of the period of extraction. This is accomplished by raising the temperature of the flask (*A*) so that the ether may evaporate as rapidly as it filters into the flask.

E. The glass extraction tube or thimble.

F. Walls of the lower portion of the extractor.

H. The lower end of the condensing portion of the extractor, perforated at *G* to permit ether vapor to pass upward, and bent at an angle at the bottom so that the drops of liquid ether are delivered at the center. This part serves as a support for the thimble and is made sufficiently long to permit of the use of thimbles of various lengths.

The upper condensing portion of the extractor is of straight thin-walled glass and sufficiently long to insure condensation of the ether vapor.

The apparatus may be used singly or in battery form. The outer tubes of the condensers may be of glass, but if hot water is used in them, as described later, they should be made of metal. They are connected with the inner tubes by means of rubber stoppers.

The rubber cup (*B*) binds the flask firmly to the extractor, so that rubber bands or devices for lowering or raising the bath below or the condensers above, for maintaining the connection with the flask, as in the Knorr apparatus, are rendered unnecessary.

The cup also carries continually in its channel a proper amount of mercury for sealing.

In connecting and disconnecting the flask a straight cork fitting the inside of the neck of the flask (*A*) is inserted to prevent anything from falling into it as it passes through the rubber cup.

Fig. 2 shows a battery of extractors so arranged that the ether may, without disconnecting the flask, be distilled at the close of the extraction and collected practically free from moisture. The source of heat for all of the operations is an instantaneous waterheater located somewhat below and (to avoid danger from fire) to the left of the battery.

BATTERY WITHOUT ARRANGEMENT FOR RECOVERING ETHER.

In laboratories where many fat determinations are made, the use of extractors in battery form is desirable. If owing to the nature of the material to be extracted the amount of ether necessary is considered too small to render its recovery unprofitable, all of the piping necessary is that required to conduct water to and from condenser, *B*, and to connect the instantaneous water heater with each end of the bath, *E*. If the apparatus is used in this manner, the condenser, *A*, may be omitted and the calcium chlorid tube, *R*, attached directly to the right-hand end of tube, *C*, which in that case may be made shorter than otherwise. A rubber tube is placed on the end of the calcium chlorid tube so that it may be closed by means of a pinchcock.

After beginning the extraction the end of the calcium chlorid tube is kept open until the extractors are filled with ether vapor, when it is closed, and need not be opened again during the entire operation. If preferred, an automatic valve opening by pressure from within may replace the rubber tube and pinch-cock.

BATTERY COMPLETE AS SHOWN IN FIG. 2.

For the recovery of the ether the condenser *A* is necessary, and also additional piping. The detailed arrangement of the piping will be determined by the location of the heater, the waste pipes, and water supply pipes in individual laboratories.

As shown in Fig. 2, cold water, after passing condenser, *A*, flows to the water heater and thence into the bath, *E*. When the bath is once filled the water

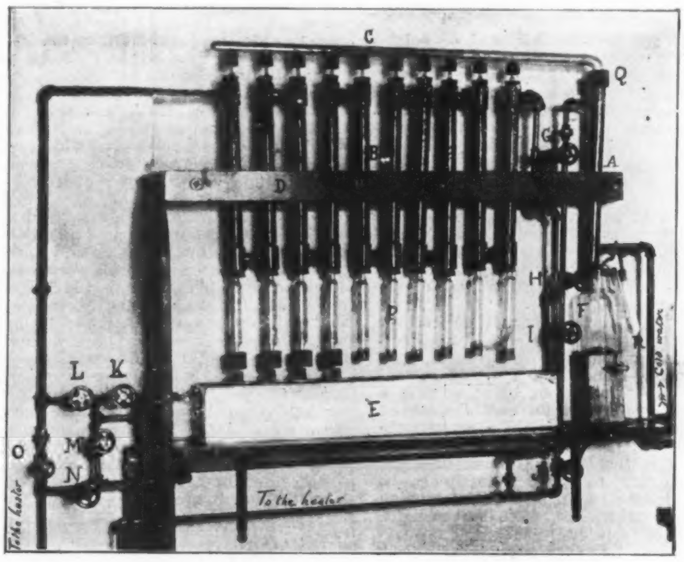


Fig. 2.—BATTERY COMPLETE.

is allowed to pass through the condensers, *B*, to the waste pipe located below and to the right of valve, *K*. During the extraction a continuous circulation is maintained from the lower right-hand end of bath, *E*, to the water heater and thence back through the lefthand end of the bath. At the close of the extraction the cold water passing through condenser, *A*, flows to the water heater, thence to the left-hand member of battery, *B*, forcing the cold water out underneath bath, *E*, into the waste pipe. As soon as hot water appears in the last member of battery, *B*, at the right, the current is diverted into bath, *E*, to vaporize the ether and assist in driving it over through condenser, *A*. The water level in bath, *E*, in the meantime is controlled by valve, *K*, in the pipe leading from the bottom of the bath to the waste; this pipe may also serve to siphon the water from the bath.

The inner tube of condenser, *A*, is straight and small enough to pass inside of tube, *C*, at the point (*Q*) where the latter is turned downward to meet it. This connection is sealed by mercury just as in the case of the flask and extractor (Fig. 1).

The tips of the inner tubes projecting through the tops of the metal condensers, *B*, are drawn down so that they can enter the downward projections on tube, *C*. Short pieces of heavy-walled rubber tubing are slipped over these, and over the pieces of tubing are passed bored rubber stoppers which clasp them and the outside of the downward projections of tube, *C*. The stopper projects considerably above the tubing so as to form a cup (about the tip) which holds sufficient mercury to produce a perfect seal over the rubber and between the two glass parts.

In setting up the apparatus the extractors, *P*, may be inserted in the condensers, *B*, before the latter are clamped into position.

The flask, *F*, is connected with the inner tube of condenser, *A*, by an ordinary cork coated with plaster of Paris. The only vent to the apparatus during the extraction and distillation is through the calcium chlorid tube, *R*, attached to flask, *F*, which is kept closed the entire time after the apparatus has first

* Published in the Jour. of the Am. Chem. Soc., 23 May, 1901, p. 338.—From the Fourteenth Annual Report of the Rhode Island Experiment Station, 1900-1901.

† Bul. 28, U. S. Dept. of Agriculture, Div. of Chemistry (1890), p. 96.

been charged with ether vapor. By this arrangement no odor of ether can be detected except when the flasks are being changed and for a few moments after the extraction begins. After removing a flask from the extractor another should either be attached immediately, or else the lower end of the extractor closed by means of a stopper to prevent unnecessary escape of ether vapor. It is desirable to insert a second flask at once in order that oxidation of the mercury by exposure to the air may be avoided as far as possible. In case the bath, *E*, is full of water, the extraction tube may be introduced or removed from the extractor without wetting by sliding it partially into a test tube.

ACTINIUM, POLONIUM AND RADIUM.

SUMMARY OF THE LATEST DISCOVERIES.

In 1898 Madame P. Curie discovered in pitch blende and chalcolyte (two ores of uranium) a new metal, polonium. Subsequently, M. Curie, Madame Curie and M. Bémont determined another element, radium. In 1899, M. Debienne characterized a third simple body, actinium. The extraction of these metals is not only quite delicate, but long and costly. To give an idea, it is sufficient to say that about 0.10 gramme of radium chloride is found per ton of ore, that is to say, the residue of the extraction of uranium.

Radium resembles barium closely; its high atomic weight, 175, assigns for it a place in the elements of high atomicity in the Mendeleef tables. Polonium resembles bismuth closely and is precipitated by hydrogen sulphide. Actinium is precipitated by ammonium sulph-hydrate and is similar to thorium.

These new elements possess extremely interesting properties, among which is that of emitting rays similar to those discovered by Prof. Roentgen in the light of the Crookes tubes.

In 1896, M. H. Becquerel, in studying phosphorescent bodies, remarked that the salts of uranium and the double salts of uranyl and of sodium, or potassium, emit special radiations having great similarity to the X-rays. These have been called Becquerel rays. The three new metals emit Becquerel rays in enormous quantity, approximatively 100,000 times greater than uranium. It seems, also, that uranium owes its property only to the presence of traces of actinium.

The radiations of radium, like cathodic rays, are deviated partly by the magnetic field. Another part is not deviated like the X-rays. The deviable rays are charged negatively.

These rays are not reflected or refracted or polarized, which is contrary to the existing conception of all vibratory movements. They discharge electrized bodies very rapidly, even through a covering of glass. The dust of the radio-active bodies renders all the objects of the laboratory radio-active. No electric measuring of precision can be done in their presence, the insulators becoming good conductors. It seems that the radio-activity is an atomic property of these bodies, that is, a property connected with the matter itself and not capable of being destroyed, either by change of physical state, or by chemical transformation. Certain bodies, zinc, tin, aluminium, brass, lead, paper, may acquire radio-activity by induction. The induced activity increases with the time of exposure and is lost gradually.

Polonium, actinium and radium so act on certain substances as to render them fluorescent, as zinc sulphides, earthy alkaline and alkaline substances, uranium salts, the diamond, blende, paper, glass, cotton.

Radium possesses the property of being spontaneously luminous. This luminosity is readily observed in semi-darkness, and the light emitted may be sufficient to allow of distinguishing written characters. The most curious fact is that the light emanates from the whole mass, contrary to what takes place in the case of ordinary phosphorescent bodies, which shine only on the surface previously impressed by the light. In moisture the luminosity is diminished, but on drying it reappears in all its intensity. It is continuous, or at least appears to be so, for at the end of a year it is not sensibly diminished.

Radiferous salts have very interesting chemical and photographic properties due undoubtedly to their radio-activity. They convert oxygen into ozone, and in general act as powerful oxidants or exciters of oxidation. Thus glass and porcelain, with oxidation of manganese are colored violet under their influence. The chlorides of sodium and of potassium are colored strongly, the latter a deep blue. The rays exert an energetic action on photographic plates, even through opaque bodies, and produce radiographs, less distinct, however, than those of the X-rays.

The applications of these substances may be numerous, provided they can be prepared in appreciable quantity and at lower cost.

Luminous indications might be made on the dials of watches and compasses. The physiological action is not less important. As slow producers of electricity the salts are indicated in the treatment of neuralgia. By application to the temples, and acting on the retina through the flesh, they may serve for diagnosing paralysis of the optic nerve.

Radium was employed in the expedition of M. Paulsen in Iceland for taking the electric tension of the atmosphere, replacing apparatus, complicated and less easy of transportation.

The curious properties of these new metals are for the most part opposed to all accepted mechanical theories, physical and chemical, for they appear to be *spontaneous producers* of light and electricity, in a word, of ENERGY. Now, it cannot be admitted that a body can produce energy indefinitely, however small the production, without borrowing from external sources, and without losing from its mass, and yet this appears to be the case with the three new metals.

According to the measuring of M. and Mme. Curie, the radiating energy is a ten-millionth part of a watt, or expressed in the displacement of matter, about one milligramme in a thousand million years.

To reconcile these phenomena with the data of science, different hypotheses have been applied. Thus M. G. Le Bon holds that the energy proceeds from very mobile chemical reactions which may take place successively a great number of times in a very short period, under the influence of simple causes, such as slight variations of temperature. This explanation is perhaps premature, for the knowledge of these bodies is very limited, and nothing yet supports the theory. Is the source of this energy external? It may be supposed that space and material bodies are penetrated with rays of a nature yet unknown and capable of reacting on radio-active substances, so as to produce a secondary emission, manifesting itself in the observed phenomena. On the other hand, it is difficult to imagine electric conductibility in the absence of every material particle; and as these rays are conductors, it may be supposed that there is an ultimate form of very attenuated matter, which these radio-active bodies may be able to emit indefinitely without losing noticeably from their mass. However it may be, the spontaneity of the radiation remains an enigma, a subject of profound astonishment. There is ground for believing that the discovery of these bodies marks a new stage in the grand history of science, and that it supports the hypothesis of the unity of matter, which has commanded the attention of philosophers for twenty-five hundred years. It is a new step toward the light, and a glimpse may be caught of the moment when the darkness which still envelops so many vast and difficult questions, shall be entirely dissipated. Science is yet in its crudest manifestations, and our minds are scarcely trained to grasp the fundamental phenomena which incessant researches are gradually unveiling.—Translated from the Revue de Chimie Industrielle.

THE WEATHER BUREAU.*

By WILLIS L. MOORE, Chief United States Weather Bureau.

ABOUT the only knowledge that most people have of the workings of the United States Weather Bureau of the Department of Agriculture is gathered from the daily predictions of rain or snow that they encounter at the breakfast table as they glance over the morning paper. They base their estimate of the utility of the weather service on the accuracy of the predictions thus hastily scanned, and many are prone to inquire whether it is true that this service has really made a place for itself in the great industrial economy of our country; whether or not an adequate return is made for the expenditure of over $1,000,000 annually; whether the science of weather forecasting has reached its highest degree of accuracy, and whether it holds cut possibilities of future improvement. They would, doubtless, be amazed if they knew the thousand and one ramifications through which it reaches, daily, probably more than one-half of our adult population.

The United States government spends more for scientific research than any other country in the world. To-day every wheel turns with scientific precision, and the arts, the manufactures, and the commerce of this wonderful country are, by the aid of systematic knowledge, being developed far beyond the dreams of the most optimistic person of a quarter of a century ago. The ingenuity of the Yankee and the skill of the American mechanic are only physical and outward manifestations of the inward spirit whose life has been called into existence by the many schools, colleges, and polytechnic institutions with which our broad land is dotted and which, through the knowledge that they reveal of the forces of nature, enable man to harness the invisible powers and make them obedient to his will. Probably in no way have we shown our aptitude in divining from apparent confusion some fundamental principles, and in applying those principles to the commerce and the industry of our country, more than in the development of the present meteorological service. Where but a few years ago man thought that chaos reigned supreme we are now, by the aid of simultaneous daily meteorological observations, able to trace out the harmonious relations of many physical laws that were previously but little understood.

DEVELOPMENT OF METEOROLOGICAL SCIENCE.

It will be interesting to note that, at the time of the founding of the first of the Thirteen Colonies, at Jamestown, Va., in 1607, practically nothing was known of the properties of the air, or of methods for measuring its phenomena. It was not until 1643, twenty-three years after the landing of the Pilgrims on Plymouth Rock, that Torricelli discovered the principle of the barometer, and rendered it possible to measure the weight of the superincumbent air at any spot where the wonderful, yet simple, little instrument might be placed. Torricelli's great teacher, Galileo, died without knowing why nature, under certain conditions, abhors a vacuum; but he had discovered the principle of the thermometer. The data from the readings of these two instruments form the foundation of all meteorological science. Their inventors as little appreciated the value of their discoveries as they dreamed of the great western empire which should first use their instruments to measure the inception and development of storms.

About one hundred years after the invention of the barometer, namely, in 1747, Benjamin Franklin, patriot, statesman, diplomat, and scientist, divined that certain storms had a rotary motion and that they progressed in a northeasterly direction. It was prophetic that these ideas should have come to him long before any one had ever prepared charts showing observations simultaneously taken at many stations. But although his ideas in this respect were more important than his act of drawing the lightning from the clouds and identifying it with the electricity of the laboratory, his contemporaries thought little of his philosophy of storms. It remained for Redfield, Espy, Maury, Loomis, and Abbe, one hundred years later, to gather the data and completely establish the truth of that which the great Franklin had dimly yet wonderfully outlined. Although American scientists were the pioneers in discovering the rotary and progressive character of storms and in demonstrating the practicability of weather services, the United States was the fourth country to give legal autonomy to a weather service; but no one of the other countries had an area of such extent as to render it possible to construct such a broad synoptic picture of air conditions as is necessary in the making of the most useful forecasts. It would require an international service, embracing all the countries of Europe, to equal ours in the extent of area covered.

Congress authorized the first appropriation of $20,000 to inaugurate a tentative weather service in 1870. Gen. Albert J. Myer, to whom was assigned the chiefship of the new meteorological service, doubtless had no conception of the future wonderful extension of the system that he was then authorized to begin. It is comparatively easy, with the great system now at our command, and with scientists who have had twenty years' experience in watching the development and progression of storms, to herald to the shipping and other industries of the United States forewarnings of coming atmospheric changes that may be destructive to either life or property. Former Secretary of Agriculture J. Sterling Morton did much to place the meteorological service of the government on a suitable foundation by having all of its employés and higher officials classified and placed within the civil service. This was essential to the proper performance of the then existing duties of the service. The present Secretary of Agriculture, James Wilson, has continued the merit system in the Weather Bureau, and has greatly improved and extended its operations. Thanks to his policy of development, the Weather Service has had a phenomenal growth during the past four years.

EXPANSE OF ATMOSPHERIC FIELD SURVEYED BY THE FORECASTER.

It is a wonderful picture of atmospheric conditions that is presented twice daily to the trained eye of the weather forecaster. It embraces an area extending from the Atlantic to the Pacific, from the north coast of South America over Mexico, the islands of the West Indies and the Bahamas, northward to the uttermost confines of Canadian habitation. It is a panoramic picture of the exact air conditions over this broad area that is twice daily presented to the study of our experts. Hurricanes, cold waves, hot waves, or rainstorms are shown wherever present in this broad area. Their development since last report is noted, and from the knowledge thus gained their future course and intensity is quite successfully forecast. Every twelve hours the kaleidoscope changes, and a new graphic picture of weather conditions is shown. Nowhere else in the world can meteorologists find such an opportunity to study storms and atmospheric changes.

TANGIBLE RESULTS OF WEATHER BUREAU WORK.

Has the Weather Bureau won its way into the hearts and confidence of the American people, and do we feel that the expenditures made for its support are wisely made? Let us answer this question by giving some facts relative to the number of people and industries that are daily in communication with the Bureau. In our Atlantic and Gulf ports, alone, there are floating over $30,000,000 worth of craft on any day of the year; and at every port, whether on the Atlantic, on the Pacific, or on the Lakes, there is either a full meteorological observatory or else a storm-warning displayman who attends to the lighting of the danger lights on the storm-warning towers at night, to the display of danger flags by day, and to the distribution of storm-warning messages among vessel masters. This system is so perfect that the Chief of the Weather Bureau, or the forecaster on duty at the Central Office, can dictate a storm warning and feel certain that inside of one hour a copy of the warning will be in the hands of every vessel master in every port of material size in the United States, provided that it is his desire that a complete distribution of the warning be made. As a matter of fact the storm warnings usually go only to a limited portion of the coast at one time. While the daily predictions of rain or snow, by which, as previously stated, the public measures the value of the weather service, are subject to a considerable element of error, namely, about one failure in five predictions, the marine warnings of the service have been so well made that in over six years no protracted storm has reached any point of the United States without the danger warnings being displayed well in advance. As a result of these warnings the loss of life and property has been reduced to a minimum, being doubtless not more than 25 per cent of what it would have been without this extensive system, which comes daily, and almost hourly, into communication with mariners. The public does not appreciate this part of the service that, as a rule, these warnings do not appear in the newspapers because it is not desirable to publish them so far in advance as to unnecessarily hold shipping in port. We only aim to place warnings twelve to sixteen hours in advance of the coming of the storm, and then we communicate by telegraph, by messenger, and by warning lights and flags directly with the masters of vessels. It is a notable example of the utility of the new West Indian weather service, and of the wisdom of Congress in continuing as a perpetual instrument of peace the service organized to meet an emergency of war, that the Galveston hurricane was detected on September 1, at the time of its inception, in the ocean south of Porto Rico, and that the new system of West Indian reports gave us such complete simultaneous data that at no time did we lose track of the storm, and everywhere, as it progressed northward, such full information was given that, notwithstanding the extensive commerce of the Gulf of Mexico, little or no loss of life or property occurred upon the open waters of the Gulf, and the destruction at Galveston was many times less than it would have been without the premonition that was given and the activity of the Bureau's officers in urging people to move from the low ground of the city to its more secure portions. Again, as this storm recurved and passed over the Lake region, the storm warnings were so well distributed that, notwithstanding that the energy of the storm was so great that few vessels were stanch enough to live through its fury, shipping remained safely in harbor and there was not a life lost. These are some of the utilities of which the general public is not thoroughly informed.

COLD WAVE WARNINGS.

When a marked cold wave develops in the north plateau of the Rocky Mountains and, by its broad area and great barometric pressure, threatens to sweep southward and eastward with its icy blasts, the meteor-

* Written for the Chicago Record-Herald.

ological stations of the Bureau are ordered to take observations every few hours in the region immediately in advance of the cold area and to telegraph the same to headquarters. By this means every phase of the development of the cold area is carefully watched, and when the danger is great each observatory in the threatened region becomes a distributing center, from which warnings are sent to those who have produce or perishable articles of manufacture that need protection against low temperatures. In such cases the system of distribution is so perfect that it is not uncommon for the Bureau to distribute 100,000 telegrams and messages inside of the space of one or two hours, so that nearly every city, village, and hamlet receives the information in time to profit thereby. What this means to the farmer and shipper is well illustrated by the fact that we gathered from those personally interested statements relative to the sweep of one cold wave, which showed that over $3,400,000 worth of property that would have been destroyed by the low temperatures was saved. To be sure, sometimes the surging of the great air eddies which constitute our rainstorms and cold waves—one the low-pressure eddy and the other the high-pressure eddy—deflects the course of the storm or minimizes the degree of cold, and the warnings may partially or wholly fail of verification; but in these important atmospheric disturbances the warnings are justified in such a large proportion of cases that those whose property is at stake do not longer question the utility of the government service. That no other country brings its citizens into such close touch with its weather conditions is shown by the fact that even when severe storms are not imminent there is, in addition to the printing of the forecasts in the daily press, a daily distribution of 80,000 telegrams, maps, and bulletins, that place the information in the hands of millions whose personal interests are materially affected by the weather.

There are over 2,000 daily papers in the United States, and each one of these prints in a conspicuous place the daily weather predictions. Did it ever occur to you that there is no other information that receives publication and attention by readers each day of the year in every daily paper in the country? There are 47 tri-weekly papers in the United States, 434 semi-weekly, and 14,734 weekly publications, the greater number of which publish the weekly weather crop bulletins of the Bureau for their respective States. Each State forms a section of the national service, and from a central office issues monthly reports on the minute climatology of the State. This climatological data is gathered from standard thermometers and rain gages that are placed in each county. The information finds extensive publication also in the weekly and monthly periodicals.

VALUE OF THE WEATHER SERVICE TO RURAL INDUSTRIES.

Few people realize what a complete system the Weather Bureau forms for the accurate and rapid collection and dissemination of crop information. It has 1,200 paid and skillfully trained officials, outside of Washington, who are quite evenly distributed over the continent and its island possessions, and who are available to report on any matters concerning weather, crops, climate, or statistics. It has 200 officials and employes at the Central Office in Washington. It has 180 fully-equipped meteorological stations quite equidistantly scattered over the United States and its dependencies, each manned by from one to ten trained officials, which stations are not only weather observatories, but are centers for the gathering of statistical and climate and crop reports. It has a central observatory in each State and Territory to which all subordinate offices in the State report, and to which all voluntary weather and crop observers report. These central observatories are equipped with printers, printing plants, trained meteorologists and crop writers, clerks, and messengers. During the past fifteen years the work of the substations and voluntary crop and weather observers has been so systematized under the State central offices that these centers constitute the most efficient means for the accurate and rapid gathering, collation, and dissemination of statistical and climate and crop information. The State central offices are under the systematic direction of the Central Office in Washington. The Central Office at Washington is equipped with cartographers, printers, pressmen, lithographers, and elaborate addressing and mailing appliances for the printing and mailing of large quantities of national weekly, monthly, quarterly, or annual reports and bulletins. The telegraph circuits of the Weather Bureau are ingeniously devised for the rapid collection, twice daily, of meteorological reports; they are also used to collect the weekly national crop bulletin. The Weather Bureau has 315 paid temperature and rainfall reporters who are now daily telegraphing their data from the growing fields to certain cotton, corn, and wheat centers. The Bureau has 250 storm-warning displaymen distributed among the ports along the Atlantic, Gulf, and Pacific coasts and in the Lake region. The Bureau has an observer serving each morning on the floor of each important board of trade, commercial association, or cotton or maritime exchange in the country, who displays weather and crop information and each day charts the weather reports on a large map. The Weather Bureau has 3,000 voluntary observers—nearly one for each county in the United States—equipped with standard thermometers, instrument shelters, and rain gages, who have for years intelligently served the government by taking daily weather observations and rendering weekly crop reports to State central offices. There are 14,000 persons reporting weekly to the climate and crop centers on the effect of weather upon the crops in their respective localities. These voluntary crop correspondents could quickly be increased in number to several hundred thousand if occasion required. In one month of four weeks there are printed and distributed 168 different State crop bulletins, four national crop bulletins, and 42 monthly eight-page State climate and crop bulletins. The weekly State crop bulletins are written by the directors of the different State sections, and the weekly national crop bulletin by Mr. James Berry, Chief of the Climate and Crop Division of the Weather Bureau, a man who has had many years' experience as a writer on crop conditions in the United States.

BENEFITS TO FRUIT AND SUGAR GROWERS.

The utilities of the weather service are well illustrated by the benefits that the fruit interests of California derive from the rain warnings, which, on account of the peculiar topography of that region, are made with a high degree of accuracy but a few hours before the coming of the rain, yet far enough in advance to enable the owners of vineyards, most of which are connected by telephones, to gather and stack their trays, and thus save the drying raisins from destruction. Along the Rocky Mountain plateau and the eastern slope our stations are so numerous and our system of distribution so perfect that the sweep of every cold wave is heralded to every ranch that has telegraphic communication. In the cranberry marshes of Wisconsin the flood gates are regulated by the frost warnings of the Bureau, and where formerly a profitable crop was secured only once in several years, it is now a rare exception that damage occurs. As we go farther south and east into the Gulf and South Atlantic States, our frost warnings are made with a greater degree of accuracy than in any other part of the country. We find the growers of sugar cane in Louisiana, the truck growers from Norfolk south to Jacksonville, and the orange growers of Florida timing their operations by the frost warnings of the Bureau. From the estimates of these people, it is indicated that the amount annually saved to them is far greater than that expended for the support of the entire Department.

FLOOD WARNINGS.

No less valuable is the flood-warning service which is in operation along our large river courses. So much advance has been made in forecasting flood stages that it is now possible to foretell three to five days in advance the height of navigable rivers at a given point to within a few inches. The danger line at every city has been accurately determined and charted, so that when a flood is likely to exceed the danger limit residents of low districts and merchants having goods stored in cellars are notified to move their property out of reach of the rising waters. An illustration of the efficiency of this system was shown during the great flood of 1897. Throughout nearly the whole area that was submerged the warning bulletins preceded the flood by several days, and the statisticians of the government estimate that $15,000,000 worth of live stock and movable property was removed to high ground as the result of the forewarnings. These warnings are distributed from fifteen river centers, at each of which a trained forecaster is located who daily is in possession of such measurements of precipitation on watersheds and such up-river water stages as are necessary to enable him to make an intelligent prediction for his own district. On account of the recent disasters from floods in the rivers of Texas steps are now being taken to establish a flood-warning service specially for that State.

Measurements of snowfall in the high mountain ridges of Montana, Wyoming, Idaho, Utah, Arizona, and New Mexico during the past several years have given us information that now enables us to make a very accurate estimate in the spring as to the supply of water from this source that can be expected during the growing season. In this way the weather service has been brought into close contact with those interested in irrigation, and has become a valuable aid to them.

The heavy responsibility that rests upon the Weather Bureau in the making of storm warnings is gathered from the statement that 5,628 transatlantic steamers and 5,842 transatlantic sailing craft enter and leave ports on the Atlantic seaboard during a single year. The value of their cargoes is more than $1,500,000,000. Our coastwise traffic is also enormous. In one year more than 17,000 sailing vessels and 4,000 steamers enter and leave port between Maine and Florida. Their cargoes are estimated to be worth $7,000,000. From these facts one can readily measure the value of the marine property that the Department of Agriculture, through the Weather Bureau, aims to protect by giving warning of approaching storms.

The climatology of each State is now so well determined and the information is so systematically collated as to be drawn upon daily by thousands of those engaged in public enterprise, such as the building of water works, where it is essential to know the precipitation on given watersheds; the building of culverts, where the extremes of rainfall within short periods must be known; the building of great iron or steel structures, where the expansion and contraction of metal with changes of temperature must be accounted for; the speculation in land in regions that are not known to the purchaser, and the selection of residences for health and pleasure.

It is not generally known that the meteorological records daily appear in numerous of the courts of the land, and that many important cases at law are settled or greatly influenced by them.

Under the direction of Secretary Wilson, we have recently arranged with Europe and the Azores Islands for the receipt of meteorological reports that, in connection with our present extensive system, enable us to forecast wind direction and wind force for transatlantic steamers for a period of three days out from each continent. This is an extension of the meteorological service that has long been sought by mariners. The new German cable from Lisbon to New York enables us to get direct communication with several islands, the reports from which are necessary in the taking up of this new and important work.

Recently the Post Office Department, through its rural mail delivery, has placed at the disposal of the Weather Service one of the most efficient means of bringing its daily forecasts, frost and cold-wave warnings to the very doors of those who can make the most profitable use of them. The latest forecast of the weather is printed on small slips of paper and each carrier is given a number equal to the number of houses on his rural route. Thus does the meteorological service insinuate itself into every avenue that promises dissemination of its reports. To be forewarned is to be forearmed. The last appropriation for the support of the Weather Bureau was $1,058,320. It is the opinion of many insurance and other experts that the meteorological service of the United States government is worth over $20,000,000 annually to the agriculture, the commerce, and the industry of the country; and this notwithstanding the large element of error that must for a long time to come enter into its predictions.

It may be asked what are the prospects for an improvement in the accuracy of the weather forecasts during the coming century. To this it may be answered that when our extensive system of daily observations has been continued for another generation or two a Kepler or a Newton may discover such fundamental principles underlying weather changes as will make it possible to foretell the character of coming seasons. If this discovery be ever made it will doubtless be accomplished as the result of a comprehensive study of meteorological data of long periods covering some great area like the United States. While we can not make such predictions to-day, we feel that we are laying the foundation of a system that will adorn the civilization of future generations. At the present time I know of no scientific man who essays to make long range predictions, and in closing this paper I would especially caution the public against the imposture of charlatans and astrologists who simply prey upon the credulity of the people. I believe it to be impossible for any one to make a forecast based upon any principles of physics or upon any empiric rule in meteorology for weeks and months in advance. The Weather Bureau takes the public into confidence in this matter, and does not claim to be able to do more than it is possible to accomplish.

It is to be regretted that the American press, the ablest and the most heroically honest of any in the world, does in many cases not only print the twaddle of long-range weather forecasting frauds, but actually pays for the privilege. A large number of our rural press is imposed up by these forecasts, and in publishing them become the disseminators of gross error instead of enlightenment.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Railroads in Russia.—The Russians are congratulating themselves, as well as the traveling public and commercial world, on the completion of the Chinese Eastern Railway through Manchuria, the extension of the Trans-Siberian Railway which furnishes direct connection between St. Petersburg and Port Arthur. It is expected that the trip will be made in less than twenty-eight days in the near future.

It is now just ten years since the first tie was laid on the Trans-Siberian Railway, which has been built from start to finish by Russian engineers and workmen, laboring under great difficulties and adverse climatic conditions, at a cost of 335,000,000 rubles ($172,525,000).

The distance from St. Petersburg to Vladivostock is 6,677 miles, and the fare is as follows:

	Rubles.	
First class	250 =	$128.75
Second class	170 =	87.55
Third class	90 =	46.35

DETAILS OF DISTANCE AND COST.

Route.	Distance.		Time in transit.	Rate.	
	Versts.	Miles.		Rubles.	
From Moscow to Irkutsk:					
First class—					
By express train			9 days	110.00	$56.65
By ordinary train			11 days	71.00	36.56
Second class—					
By express train			9 days	69.00	35.53
By ordinary train			11 days	43.00	22.14
From Irkutsk to station Barantchiki (by rail)	92	60.9	6 hours		
From Barantchiki to Massovaya, across Baikal (by steamboat or sledges)	62	41.1	4½ hours	*18.37	9.46
From Massavoya to Stretiensk (by rail)	1,034	685.5	4 days		
From Stretiensk to Blagoviestchensk (by steamboat)	1,137	753.8	8-12 days	11.37	5.85
From Blagoviestchensk to Khabarovsk (by steamboat)	911	603.9	6-9 days	9.11	4.69
From Khabarovsk to Vladivostock (by rail)	716	474.7	1 day	10.20	5.25
From Vladivostock to Port Arthur (by rail)			4 days	†55.00	28.32
From Khabarovsk to Port Arthur, via Nikolskoye			6 days		

* Second class. † First class, with board.

The Manchurian road consists of two branches: The principal, from the station Manchuria to Sungari, 876 versts (580.7 miles) long; and the south line, from Sungari to Port Arthur, 924 versts (612.6 miles). The Ussurijsk line to Vladivostock is 208 versts (137.9 miles) in length.

The Trans-Siberian road was built with light rails—some of which only weighed 12 pounds to the foot—wooden bridges, light equipment, cars without trucks; and in many cases, the track was laid on marshy soil. As a consequence, it has been impossible to make time or take care of the business offered. These defects, however, are being remedied as rapidly as the means can be provided to meet the expenses, which in some sections will amount to 50 per cent of the original cost.

The conductors, porters, and trainmen are all Russians and do not understand English, but occasionally one is found who speaks a little German or French.

The route is through a country resembling Kansas and Nebraska, and is quite as hot and dusty during the summer months.

It requires eight days to make the journey over the first part of this road, which ends at Irkutsk, where all passengers change cars. Trains leave Moscow for Irkutsk twice a week—Wednesdays and Saturdays at 8 o'clock P. M.—and leave Irkutsk for Moscow on Mondays and Fridays at midnight. Each train consists of nine cars, and they carry second-class carriages as well as first, and are very comfortable; the passengers all eat in the same restaurant cars, and excellent buffets are to be found at the various stations on the route.

The train de luxe, consisting of vestibuled cars, leaves Moscow every ten days. The cars are high and

roomy, and are lighted by electricity. Each has four compartments, exclusive of the general parlor, which is in the center, and is provided with a table, lounging chair, maps, mirrors, etc. Three of these compartments are for four persons and one is for two. The berths run crosswise, are unusually high and are luxuriously furnished. The wood is of a dark-red color, ceilings white, and the walls are overlaid with gray stamped leather. The divans are covered with dark-red leather, and are converted into beds at night. There are plenty of racks for baggage and hooks for clothing. The floor is covered with linoleum in the summer and heavy carpet during the winter. In the aisle along the side into which the rooms open, there are collapsible seats, which will answer for a short time while looking at the scenery. There are call bells for the porter and waiter in the restaurant car. The toilet rooms on this train are tiled and the upper part is of light wood, but both sexes use the same room and travelers are advised to carry their own toilet articles. There is plenty of cold water, which is a luxury on a European railway train. Little or nothing is seen of the porter after he makes up the beds in the morning, and the presumption is he sleeps all day. At the rear of the last car is an observation parlor, from which a fine view of the country can be had.

It is a three-hour ride from Irkutsk to Lake Baikal, which is crossed by steamer during the summer and by sledges (in seven hours) during the winter. The railroad is being built on the south bank of the lake, but will not be completed before 1903.

The Trans-Siberian train leaves the east bank of the lake on the arrival of the boat and proceeds to Stretiensk, on the Chilka River, the actual terminus of the line, a sixty-four hour run. Steamers with indifferent accommodations and food run regularly from Stretiensk to Khabarovsk, on the Amur River, which occupies fifteen days, more or less, according to the depth of the water and length of stoppages.

The railway is completed from Khabarovsk to Vladivostock, a distance of 400 miles, requiring twenty hours for transit.

From Vladivostock, there are steamers with connections for Japan, Korea, and Shanghai, any of which can be reached in six days, while San Francisco can be reached in fifteen days.

Prince Hilkoff, the Minister of Ways and Communications, has recently issued a valuable guide to the Trans-Siberian Railway in English, containing all the information the average traveler desires to have about the history, country, trade, people, etc., on the line of this great highway. It is handsomely illustrated and covers 520 pages, and can be purchased in Paris and London for $3.25.

Russia realizes the absolute necessity for additional railroads, in order to move her crops and insure the settlement of her uninhabited territory, and has already made elaborate plans for the next decade; but while she possesses natural resources of practically unlimited value, she lacks for the present the ability to build the roads without the aid of foreign capital.

In view of the recent loan successfully floated in France, which will, it is believed, be used to build new railroads, the following will be of interest.

The February earnings of railroads in European Russia were 27,038,362 rubles ($13,914,636), against 26,952,885 rubles ($13,880,736) in the previous year, an increase of 85,477 rubles. In the first two months of the present year, the gross earnings were 56,463,062 rubles ($29,078,477), and for the same period of the previous year 54,635,629 rubles ($28,137,349), an increase of 1,827,433 rubles ($951,128). It appears that during the same period there was a decrease in passengers this year of 258,598, but an increase in freight of 43,974,000 poods (793,994 tons).

The greatest prospects of railroad building in European Russia are lines direct to Viatka and Kief. The first would, it is estimated, open the enormous agricultural northern district and very materially affect the importance of St. Petersburg. A direct line to Kief would diminish the time taken in going to that town by at least one-half.

An imperial ukase has been issued, ordering the construction of the Orenburg-Tashkent Railroad, in order to relieve the famine-stricken population of the eastern provinces of Russia, and give employment to the iron works in the same provinces, which are suffering from want of activity.

The new line runs from Orenburg to the Iletzki station, thence along the northern shore of the Caspian Sea to Kazalinsk, on the Syr-Daria River, through the towns of Perovsk, and Djulek, Turkestan, and digresses somewhat north from the current of the Syr-Daria, toward Tashkent. The line will be 1,762 versts (1,068 miles) in length. From Orenburg to the Mugodjarsk Mountains, it will cross an area of 400 versts (265.2 miles) of good farming land, besides touching the rich Iletzki salt mines. The next district is a desert, where the nomad Kirghiz live. From Kazalinsk, the line will cross the fertile valley of Syr-Daria, with a population of 1,500,000, whose trade amounts to about 50,000,000 rubles ($25,750,000) per year. The Tashkent and Chikment districts are the principal exporters of cotton, and they will be given a new market by means of this line.—W. R. Holloway, Consul-General at St. Petersburg.

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